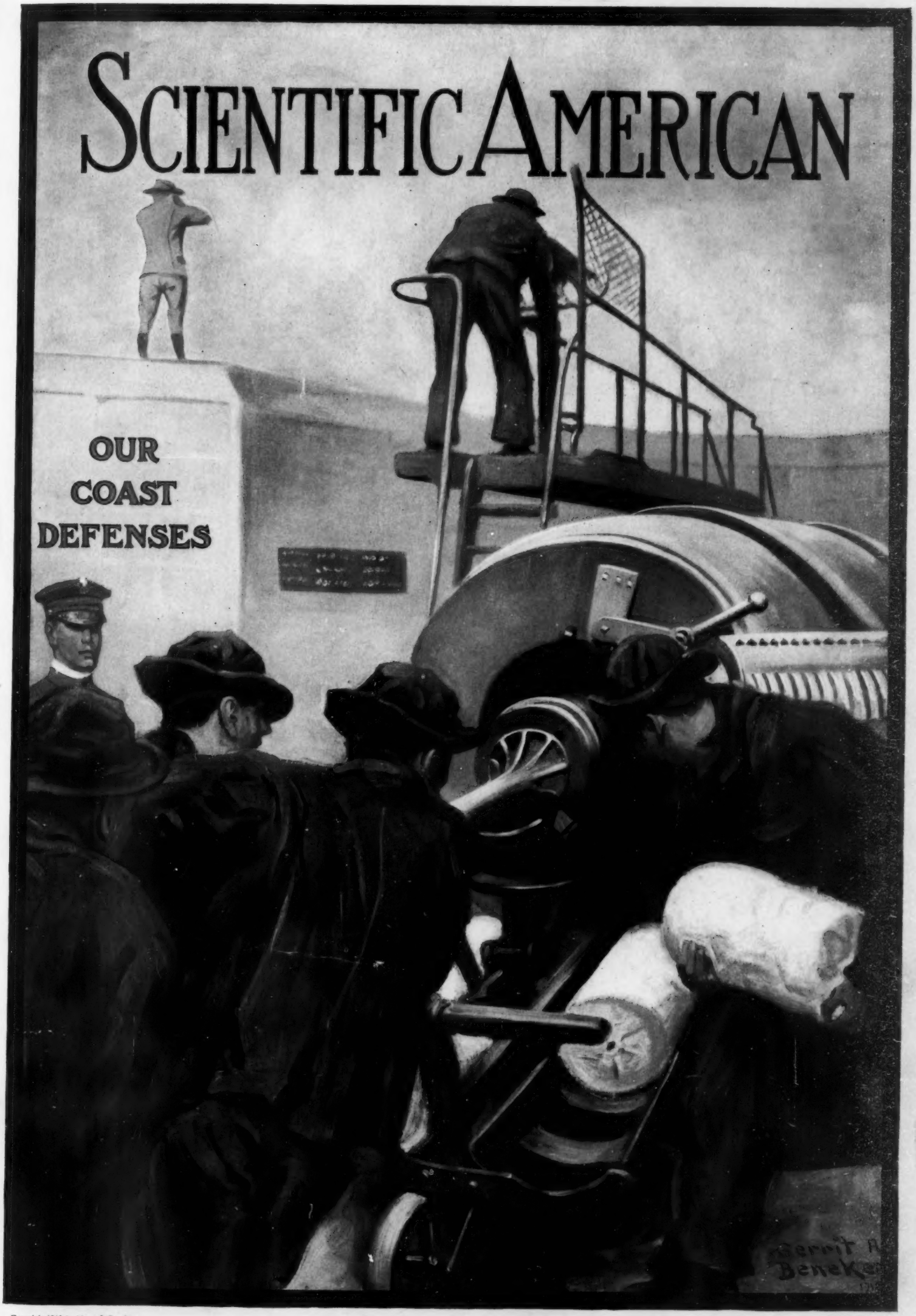
SCIENTIFIC AMERICAN



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Vol. CVI. No. 20
May 18, 1912

Munn & Co., Inc., Publishers
New York, N. Y.

Price
15 Cents

Overland

$1200

Model 60-T

Wheel base, 111 inches; body, 5-passenger, fore-door touring; motor, 4⅛ x 4½; horsepower, 35; Remy magneto; front axle, drop forged I section, Timken bearings; tires, 34x4 inch Q. D.; equipment, three oil lamps in black and brass finish, two gas lamps and generator. Self-starter, $20 extra. Top and glass front, $55.

HERE is the lowest priced thirty-five horsepower touring car made. A thorough investigation of the entire automobile market will reveal the startling fact that practically the only difference in popular priced cars to-day is the difference in price and this difference is due to the size of the plants that produce them.

That is why we, the largest individual manufacturers in the business, can market a thirty-five horsepower five-passenger touring car for $1200. If the others are getting $1500 for a car of this type, *which they are*, why should you pay it?

Look up the Overland dealer in your city. See this exceptional $1200 car. He will supply you with all the evidence in the world to back up these statements. Let us send you one of our interesting books. Please ask for book F 25.

The Willys-Overland Company, Toledo, Ohio

No-Rim-Cut Tires—10% Oversize

Our Average Profit is 8½%

When one maker of anything outsells every rival—reaches the topmost place—it is well to know the reason why.

It means that more people approve his creation than anything else of its kind.

It means that the maker, in some way, has accomplished what others haven't.

And the chances are you would join the majority, knowing what they know.

When the article in question involves big yearly expense, the facts are worth looking up.

Goodyear No-Rim-Cut tires now hold the topmost place. They far outsell all rivals.

In the past 24 months the demand has increased by over 500 per cent.

Over one million of these tires have been tested, on some 200,000 cars.

The demand today—after all that experience—is three times larger than one year ago.

That astounding record—rarely excelled in all the history of business—marks a tire, Mr. Motorist, which you ought to know.

Ten Years Spent Getting Ready

The success of this tire is a sudden sensation. But we began to perfect it 13 years ago.

We started with the idea that he who gives most will get most.

So we surrounded ourselves with experts—the ablest men we could find. And we told them to secure the *maximum mileage*, without any regard to expense.

It was years before we approached tire perfection. It was *ten years* from the start before tire buyers realized what the Goodyear concern had done. Then came this avalanche of trade.

Mileage Tests

To learn facts quickly we did two things.

We put Goodyear tires on thousands of taxicabs—where mileage is known, where conditions are arduous, where comparisons are quickly made.

And we built in our shops a tire testing machine. There four tires at a time are constantly worn out, under all road conditions, while meters record the mileage.

Thus we compared every fabric and formula, every grade of material, every method of wrapping and vulcanizing.

Thus every idea which our experts developed was put to the mileage test. Thus rival tires were compared with our own.

Thus year after year Goodyear tires were made better. In the course of time we got close to finality.

Rim-Cutting Ended

Then we found a way to end rim-cutting—a method controlled by our patents.

We examined thousands of ruined old-type tires, and we found that 23 per cent had been rim-cut.

By ending this trouble—at vast expense—we saved that 23 per cent.

In seven years' experience with No-Rim-Cut tires there has never been an instance of rim-cutting.

Adding 25 Per Cent to the Mileage

Then we found that extras added to cars were overloading tires.

So we made these tires—No-Rim-Cut tires—10 per cent over the rated size.

That meant 10 per cent more air—10 per cent added carrying capacity. And that, with the average car, adds 25 per cent to the tire mileage.

With these tires of maximum quality—made oversize, made so they can't rim-cut—we met the prices of other standard tires.

Average Profit 8½%

Last year our average profit on No-Rim-Cut tires was 8½ per cent.

Every penny we got, save a profit of 8½ per cent, went into size and quality.

That in a factory with the largest output and most modern equipment ever known in this industry.

That in a risky business, with fluctuating materials, on a tire that's guaranteed.

You will never get more for your money—more mileage per dollar spent—than in Goodyear No-Rim-Cut tires. That must be apparent to you.

The proof of that fact has brought 200,000 motorists to the use of these premier tires.

Our 1912 Tire Book—based on 13 years of tire making—is filled with facts you should know. Ask us to mail it to you.

GOODYEAR
AKRON, OHIO

No-Rim-Cut Tires

With or Without Non-Skid Treads

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

Branches and Agencies in 103 Principal Cities

We Make All Kinds of Rubber Tires, Tire Accessories and Repair Outfits

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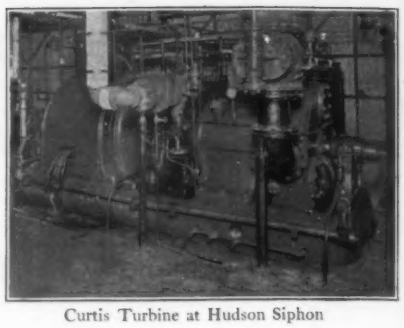
(606) (606)

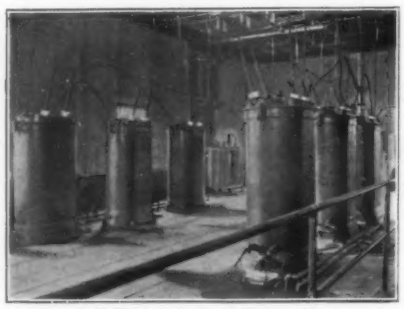
Electric Power is Building the World's Greatest Aqueduct



Curtis Turbine at Hudson Siphon

Electricity is building a very large part of the Catskill Aqueduct, which is ranked by many engineers as second only to the Panama Canal. This 127 mile Aqueduct extends from Ashokan Reservoir to Staten Island. It passes under rivers, lakes and arms of the sea.

Over 90% of the electrical apparatus used was made by the General Electric Company. It furnishes power for every operation necessary besides effectively lighting the jobs and camps.



G-E Transformers at Forest Glen

MINING LOCOMOTIVES have replaced the slow and costly mule. The wear-forever qualities of the General Electric Company Mining Locomotives makes it possible to use the same locomotive on many contracts—the first one built a quarter of a century ago is still in successful operation.

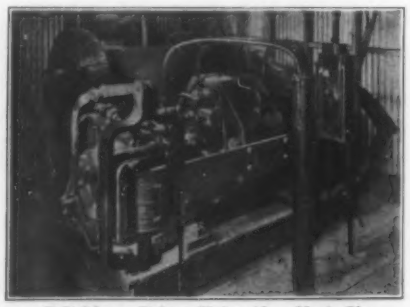
AIR COMPRESSORS driven by G-E motors are in frequent evidence throughout the Aqueduct. In both first cost and operating expense this drive is cheaper than steam engine drive. Winter's icy blast does not effect coal bills greatly where power is bought from a large efficient central station or public service corporation. The power bill also ceases in this case when compressors are not actually running.

G-E Motor Pumps under Hudson River

CENTRIFUGAL PUMPS driven by G-E motors have been found absolutely necessary down in the tunnels to handle the large leakage. In every case these pumps have proven absolutely dependable even though working under adverse conditions. They are guaranteed to pump themselves dry if flooded and can be controlled by push buttons from top of shaft if desired. They do not use up air when it is needed for the drills and one three-stage pump will handle a 1200 foot lift and require but one attendant.

G-E Motor Driving Air Compressors at Forest Glen

HOISTS AND CLAM SHELL DIGGERS are used in large numbers and are almost invariably driven by G-E motors. To start one of these hoists simply throw in a switch and operate controller. No fireman is needed to get up steam, nor is a licensed engineer required to operate it; no coal or water need be carried to it nor ashes hauled away. Cold weather does not increase the coal bill as it does for steam hoists with their exposed and consequently inefficient boilers. Reserve power in plenty is always available when using central station power.



G-E Motor Driven Hoist, New York City

ROCK CRUSHERS and CABLEWAYS are in constant operation on the Aqueduct. Here G-E motors operate as well in the grit and dirt laden air as in better protected situations.

Many a contract has been changed from a losing to a paying one by installing G-E motors. The dependable operation obtained from them, when attended by laborers of average intelligence, keeps all labor busy and reduces operating cost.

Our specialists carefully study local conditions when consulted on electric power problems and apply efficient engineering analysis to their economical solution.

G-E Locomotive Hauling Concrete New York City

General Electric Company

Largest Electrical Manufacturer in the World

Principal Office: Schenectady, N. Y. Sales Offices in the following Cities

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SIXTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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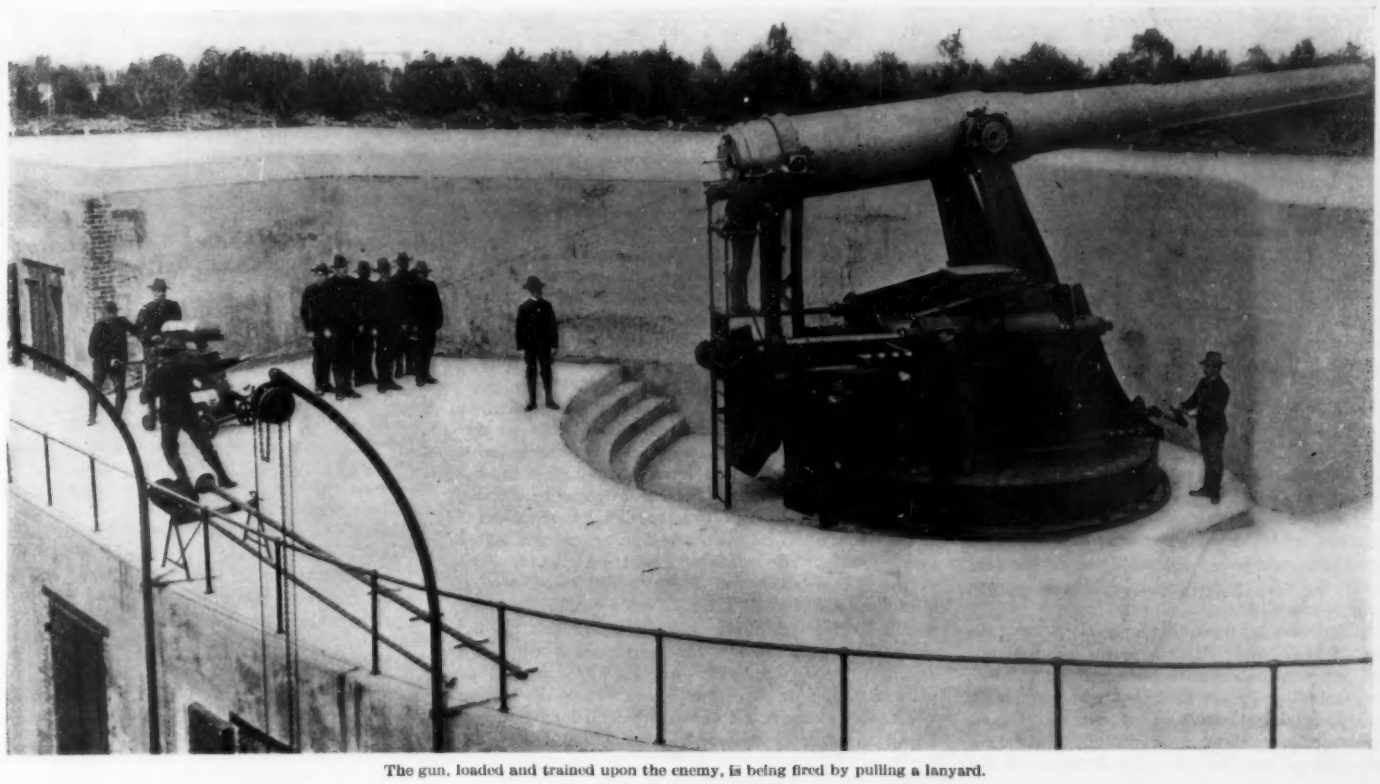
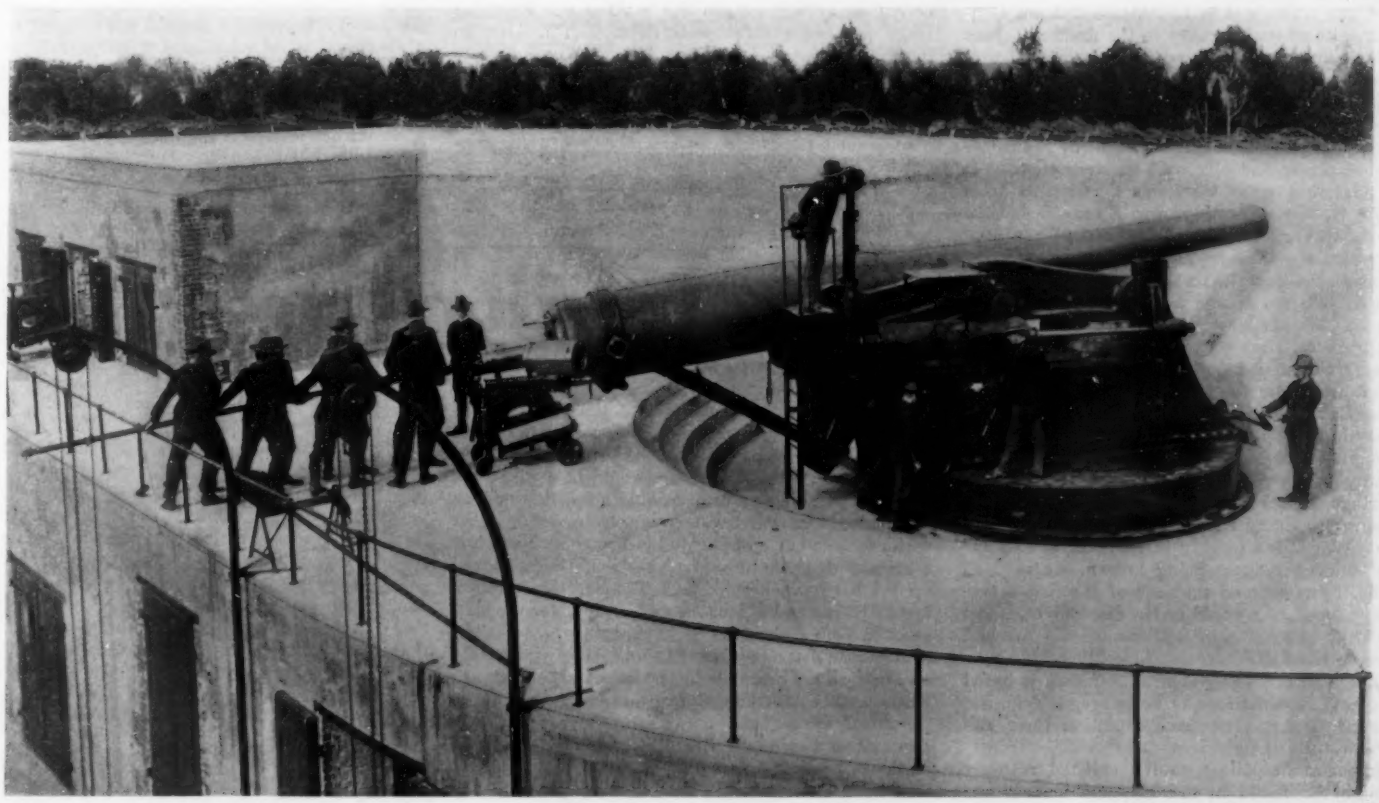


The gun, loaded and trained upon the enemy, is being fired by pulling a lanyard.

Firing a 12-inch disappearing gun at one of our coast batteries.



The shell and powder are lifted by an endless chain hoist from the magazines to the gun platform. Here it is transferred to a carriage and wheeled to the breech of the gun. The crew are shown in the act of ramming home a shell.

Loading a disappearing gun, when it is in the depressed position.

THE GUNS OF OUR COAST-DEFENSES.—[See page 440.]

SCIENTIFIC AMERICAN

Founded 1845

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Increase the Coast Artillery

THE chapters in the present issue which are devoted to a description of our coast defenses show that this important work is now practically completed. It will come as a shock, however, to the readers of the SCIENTIFIC AMERICAN, to learn that, although we have an excellent equipment of guns, mortars, and submarine mining plants, these defenses are very seriously handicapped by the fact that our coast artillery is not sufficiently numerous adequately to man them.

For many years past, in his annual report, the Secretary of War, after describing the gradual approach of our coast defenses to a state of completion, has drawn attention to the fact that when the work is done, the elaborate system of guns, mortars, searchlights and range and position finding material, will lose a large part of its value because of the inadequate number of officers and enlisted men in our coast artillery.

For reasons which it is difficult to fathom, Congress, in spite of its liberality in the matter of guns and their emplacements, has been reluctant to provide for the greatly needed increase in the enlisted force. Year after year the appeal of the Secretary of War has been allowed to go by unanswered. It would seem as though the lesson taught by the Spanish-American war had already been forgotten. Yet it is a fact that when Cervera's fleet sailed from Spain for these waters, there was a very live panic produced throughout our Atlantic Coast cities. Urgent demands were made by Congressmen from the various constituencies on the seaboard for proper protection. So great was the pressure that some warships which the navy could have used to good effect elsewhere, were sent to stand guard over the supposedly threatened positions.

Now it would be the height of folly to suppose that because Cervera and his fleet of armored cruisers proved to be so ineffectual, any future force which might be dispatched against our coasts would be equally inefficient. We may rest assured that the shortage of men in our fortifications is perfectly well known to every naval and military power in Europe. War starts quickly in these days; and our state of unpreparedness being known, we may as well take it for granted that one of the first movements of a naval war would be the dispatch of a fleet to attack our seacoast fortifications. Fully manned by a thoroughly drilled regular force, these fortifications, unless indeed our system of defenses is based on a fallacy, should prove to be impregnable. But in their present undermanned condition their efficiency is wofully impaired.

An important auxiliary to the enlisted artillery force might be found in the National Guard, and particularly among those members of it who live along our seaboard. We are aware that a part of our volunteer forces is given annual training at the seacoast fortifications; but the training is not sufficiently extensive, nor are the numbers of this force as large as the importance of our coast defenses demands.

Safety at Sea

A FLOOD of letters has descended on this office asking a thousand-and-one questions about the "Titanic" and offering as many suggestions for the future construction and navigation of passenger ships on the high seas. A few of these we have published. To the majority, it is, in the nature of things, impossible to make any separate reply. What follows will serve as an answer to the most reasonable of the questions which have been raised.

1. "TITANIC" AT THE BOTTOM.—Let it be understood in the first place, that the "Titanic," as we showed in our issue of April 27th, is to-day at the bottom of the North Atlantic in two thousand fathoms of water. As the depth increases, there is an increase of pressure, but not in density, of the water. Therefore, the "Titanic" weighs approximately the same two thousand fathoms below the surface as she did when afloat; hence, she is absolutely unrecoverable.

2. THE SEAMEN.—This disaster has proved that in the matter of ocean navigation, many fallacies have crept into our minds. Thus, we had come to believe that the day of the able seaman on passenger ships was over. Yet never was there a greater demand for him than on that fatal night of April 14th. In this connection we draw special attention to a letter published in our correspondence column signed "A Commander of One of the Passenger Ships," in which the writer shows that a trained body of seamen on any passenger ship is liable to be arbitrarily withdrawn from the ship by the action of the union, and a crew of raw seamen, who know nothing of the equipment of the ship, forced upon the captain—and this on the very eve of sailing. Here is a peril indeed, vitally threatening the safety of passenger travel on the deep seas. Most heartily do we endorse the suggestion of our correspondent, that this question of interference by the unions with the crews, and especially the seamen, of passenger ships, be made the subject of Congressional legislation.

3. STRUCTURAL CHANGES.—The article published on page 417 of our last issue answers a great number of the letters which we have received in connection with the loss of the "Titanic." To recapitulate, we would like to see the double shell extended up the sides of the ship to about the deep load line; bunkers arranged along the sides of the ship instead of athwart ship; watertight bulkheads carried two and preferably three decks above the deep load line; all bulkheads greatly stiffened to resist distortion; and no bulkhead doors permitted below the water line, and as few as possible above it.

4. HOLLOW WATERTIGHT DECKS.—We have received many suggestions for making the decks of large passenger ships watertight with a view to increasing floatation ability. There is no adequate advantage in this; for if these decks were made of cellular construction, similar to that of the double bottom, they would be so heavy as scarcely to be able to float themselves. Certainly they would render but little assistance in preventing the foundering of a ship.

5. LIFEBOAT ACCOMMODATIONS.—Perfectly reasonable is the suggestion that when the steward assigns the passenger his seat at table, he should also assign him his seat in a lifeboat. The number and position of the lifeboat should be entered upon a card and the lifeboat pointed out to the passenger. The Japanese, with characteristic pre-vision, already have followed this practice on one of their important steamship lines.

6. SEARCHLIGHTS.—In spite of the testimony of one of the officers of the "Titanic," we consider that the installation of powerful masthead or bow searchlights on transatlantic steamers would be a wise step. To avoid blinding an approaching ship, it would be advisable, in crowded waterways, to use such lights with caution; but no unprejudiced navigator will for a moment deny that a searchlight would have picked up the berg which sank the "Titanic," long before it was visible to the lookout and in time for the ship to have swung clear.

7. ESTABLISH AN ICE-PATROL.—One important outcome of the present discussion of safety at sea will be the establishment by the government of an ice-patrol during the period in which ice comes down from the Arctic Sea. This patrol should be stationed well to the north of the northern route; it should take up its position of observation at the commencement of the ice season, and continue on station until the last of the ice has come down. By this means the ice would be detected at its earliest approach and long before it entered the zone of danger, and the steamship sailing routes would be steadily shifted south in accordance with the official reports sent into the Hydrographic Office.

The Sherman Anti-trust Law and the Patent Monopoly

A READER of the SCIENTIFIC AMERICAN calls our attention to the sweeping language of the second section of the Sherman Anti-trust law, part of which section reads: *"Every person* who shall monopolize or attempt to monopolize . . . *any part* of the trade or commerce among the several States . . . shall be deemed guilty of a misdemeanor," etc. It is suggested that this squarely nullifies the general patent law which expressly grants a monopoly, and that it is a misdemeanor to control exclusively the sale among the States of articles manufactured under any patent. The words "every person" and "any part" seem to be broad enough to include even patentees.

The point raised is not novel. In the first place there is a marked difference between monopoly as conceived by the framers of the Sherman Anti-trust law and monopoly as conceived by the framers of the Constitution and of the patent laws. The monopoly against which the Sherman law is directed, deprives the public of rights. It is a monopoly that may be perpetual. In return the public gets nothing. On the other hand, the patentee takes nothing from the public. He has produced something which may enrich his country. In order that his country may profit by his work he is given the exclusive right to his invention for a limited period on condition that at the end of that period the public may enjoy his invention without restraint. Such a limited monopoly ultimately enriches the public. The monopolies against which the Sherman law is aimed may result in giving the public cheaper and better products, but the public is not positively enriched by giving it a right that it did not possess before.

The rights of the inventor are very simply and broadly defined in the Constitution of the United States. For the purpose of advancing the progress of the useful arts and sciences Congress is authorized by the Constitution to pass laws which will secure to inventors and authors for a limited period the *exclusive* right to their inventions and writings. The particular passage of the Constitution in which this word "exclusive" occurs has been construed by the Supreme Court of the United States. Invariably the word has been interpreted as meaning "absolutely unlimited." Mr. Chief Justice Marshall in Grant v. Raymond thus comments upon the constitutional privileges of the inventor: "It cannot be doubted that the settled purpose of the United States has ever been and continues to be to confer on the authors of useful inventions an exclusive right in their inventions for the time mentioned in their patents. It is the reward stipulated for the advantages derived by the public for the exertion of the individual, and is intended as a stimulus to those exertions. The laws which are passed to give effect to this purpose ought, we think, to be construed in the spirit in which they have been made, and to execute the contract fairly on the part of the United States, where the full benefit has been actually received, if this can be done without transcending the intention of the statute. . . . The public yields nothing which it has not agreed to yield; it receives all which it has contracted to receive. The full benefit of the discovery, after its enjoyment by the discoverer, . . . is preserved; and for his exclusive enjoyment of it during that time, the public's faith is pledged."

On the subject of the suppression of inventions, which seems to be giving our law-makers much concern, the Court in the case of Heaton-Peninsular Button-Fastener Co. v. Eureka Specialty Co. (77 Fed., 288, 294) comments thus: "That the grant is made upon the reasonable expectation that he will either put his invention to practical use or permit others to avail themselves of it on reasonable terms is doubtless true. This expectation is based alone upon the supposition that the patentee's interest will induce him to use, or let others use, his invention. The public has retained no other securities to enforce such expectations. A suppression can endure but for the life of the patent, and the disclosure he has made will enable all to enjoy the fruit of his genius. His title is exclusive, and so clearly within the constitutional provision in respect of private property that he is neither bound to use his discovery himself nor permit others to use it."

The very object of the patent laws is monopoly; of the Sherman Anti-trust law, the destruction of monopoly not in accord with public policy. There is nothing in the Sherman Anti-trust law that limits the right conferred by a patent. It is not unlikely that any act of Congress which would in any way affect the exclusive right conferred by a patent would be declared unconstitutional by the Supreme Court of the United States.

Engineering

Electrifying Trunk Railroads.—The New Haven Railroad at present has 114 miles of electrical tracks equipped for electrical operation. So extensive are the increases which the company is making in its electrical equipment, that by the end of next year, no less than 562 miles of the company's tracks will be electrically operated. The New York Central Road, which is using the continuous-current system, expects to have 233 miles of track electrically operated by the close of next year.

An Objection to Longitudinal Bulkheads.—It has been objected against the longitudinal bulkhead, that, in the event of heavy flooding on one side of a ship, a heavy list would be caused, which might ultimately result in total capsize. To prevent this, opposite compartments should always be connected by piping to allow the inflow of water, if so desired, to extend to corresponding compartments on the opposite side of the ship. This transverse connection could be controlled by valves and used only as desired.

The Busiest Railway Station.—According to *Engineering* the busiest railway station in the world is that of the Gare St. Lazare, Paris, for the total number of passengers arriving or departing is officially set down at nearly 45,000,000 annually. Our contemporary considers that there is nothing approaching this anywhere else, and we are inclined to agree with him. It is estimated that 35,000,000 would be the outside number dealt with in a year at the three great London termini—Waterloo, Liverpool Street and Euston.

Deepening the Hudson River at New York.—The Secretary of War, Mr. Stimson, has transmitted to Congress the report of Col. Black, engineer officer in charge of New York harbor, containing a recommendation that $1,570,000 be spent during the next five years in improving the Hudson River to meet the requirements of the big ocean steamships which run up to 23rd Street. The plan includes proposals to dredge certain places of the river for widths of several hundred feet to depths of from 26 to 40 feet.

"Nested" Lifeboats.—We are informed that the Cunard Company has already determined to make use of the system of carrying boats on deck known as "nesting." Nesting requires a boat of special construction, for the standard lifeboat could not be nested above two, or at the outside three, deep. There are types of boats, however, which would lend themselves admirably to this method of stowage, and we presume that it is one of this kind that the company above mentioned is intending to install.

Additional Admirals for the Navy.—The Naval Appropriation Bill in the House provides for two admirals and two vice-admirals for the United States Navy. The bill provides for an admiral to command each of the two fleets of the Navy, the Atlantic battleship fleet and the Pacific Harbor fleet, and also for a vice-admiral for each of these fleets. The rank of admiral is to be held by the commander-in-chief of each fleet, so long as the flag officer in command of the fleet holds that command.

Progress of Work at Panama.—Over 82 per cent of the concrete of the locks at Panama is in place. At the Gatun locks over 93 per cent of the concrete has been laid, at Miraflores over 93 per cent, and over 60 per cent of the concrete has been laid for the system of two twin locks at Pedro Miguel. On March 27th there were 36,057 employees actually at work on the canal and the Panama Railroad, and of this number 30,084 were canal employees. The so-called gold force on the canal work, composed almost entirely of white Americans, was 4,338.

Rolling Tanks on Battleships.—We understand that the latest battleship of the British navy, the "Orion," has developed bad rolling tendencies. To prevent this in future ships of that class, the rolling tank, or a modification of it, is to be installed. This tank has shown excellent results on certain passenger ships, and it should prove to be even more valuable on ships of war. Nothing is more destructive of good shooting than the quick, sharp roll of the vessel on which a gun is mounted, and the anti-rolling tank should prove to be an excellent corrective.

Philadelphia International Navigation Congress.—Special importance is given to the forthcoming International Navigation Congress to be held at Philadelphia, by the fact that only recently the world's largest steamship has been lost. At the last Congress of this kind, held four years ago, several papers were read bearing upon the general question of safety at sea. In these papers it was pointed out that although much had been accomplished, even more remained to be done to make ocean travel perfectly safe. The Philadelphia Congress will afford an excellent opportunity for the formulation of rules and the suggestion of improvements in the structure of ships, which will restore that public confidence in deep sea travel which has, of late, been so rudely shaken.

Science

Neo-salvarsan and Its Number.—Prof. Ehrlich's improved 606, which he calls neo-salvarsan, has received the official laboratory number 914, indicating that the scientist has experimented with 308 different preparations since the perfection of 606 two years ago.

Uses of Aluminium.—The use of aluminium is being constantly extended into new fields. One of the latest applications of this wonderful metal is in the form of a foil to take the place of tin foil in wrapping up food products, especially chocolate. The making of thin foils of aluminium presented serious difficulties which have been only recently overcome. Aluminium foil is now made about 1/600 of an inch in thickness. Aluminium powder has also been coming into common use. To make the aluminium powder, very thin foil is first cut up into small spangles; these are ground in a mill and the powder is then sifted through bolting cloth. The powder is used as a basis for metallic paint and is especially valuable for metallic surfaces that are exposed a great deal. The powder is very soft and adhesive, like graphite.

Important New Test for Stability of Gunpowder.—The important discovery is announced by M. M. Berthelot and Gaudechon that the action of the ultra-violet rays on gunpowder is to accelerate those changes in composition which tend to occur spontaneously in the lapse of time. Hence those alterations which are produced in the course of years by the natural agents of heat, humidity and contact with air may be made to occur within a few hours. Obviously, therefore, an examination by the ultra-violet rays offers a valuable means of testing the stability of various explosives, their condition at any given time and their rate of deterioration. Of all the powders examined that designated "B" powder was found to be the most stable when properly manufactured. This fact indicates that control of the fabrication is more important than alteration of formula. The conclusion is reached that it is advisable that the ultra-violet test should be added to the heat test already in use.

Seismology at St. Louis University.—The Meteorological and Seismological Departments of St. Louis University have issued the second interesting bulletin (Vol. III., No. 1) on meteorology and seismology. It contains several plates illustrating the various apparatus and equipment used in this work. The Meteorological Department has inserted a tabulated daily record, showing results of observations during 1910, and has also provided a monthly summary for the whole year. The thoroughness and accuracy of the forecasts are remarkable and show efficient work. From the Seismological Department there are illustrations of earthquakes recorded by the seismograph, together with records of disturbances occurring during 1911. This department has acquired such prominence in its work that St. Louis papers are enabled to publish distant earthquakes hours before the news reaches them by telegraph from the affected places. St. Louis University enjoys the distinction of being one of a vast seismological system conducted by the Jesuits. This system embraces the whole world and is the most complete arrangement extant for this work, being recognized as such by various governments. The bulletin will be mailed to those interested.

Eggs in Egypt.—The hatching of eggs by means of artificial heat has been practised in China and in Egypt from prehistoric times. In the latter country there still exist ancient egg-hatcheries or "mamals" that have been in continuous use in the same family for many generations. These incubators consist of large brick ovens that will hold about thirty to sixty thousand eggs at a time. The fire is built inside the oven and is watched carefully for ten days, after which no additional heat is necessary. The method of building the fires and maintaining them so as to preserve the right temperature are trade secrets that are jealously guarded and usually kept in the family. About sixty-five to seventy per cent of the eggs are said to be successfully hatched by these methods. The production of eggs for the export trade has come to be a very important industry of Egypt. During the winter of 1911-1912 the export amounted to 83,608,000 eggs, having a value of $627,000. That is at the rate of about nine cents a dozen. Compared to the prices paid in this country last winter, it would almost seem that it might pay to bring eggs to New York from Cairo. Most of the Egyptian eggs go to England; last year 74 million, or nearly 90 per cent, were sent there. France had over three million, and the rest were divided among a number of countries. The eggs shipped from Egypt are generally smaller than those we are accustomed to; but when we consider the amount of food material contained in them, even these small eggs are very cheap when compared with prices in this country or in Europe.

Electricity

Another Electrical Method of Forcing Vegetation.—In a recent issue a brief *resumé* was given of several electrical methods of stimulating the growth of vegetables. The importance of these systems resides largely in the high prices obtained for early produce. A British immigrant to Canada proposes to force his crops by heating the soil by underground electric wires spaced about five feet apart and one foot under the surface, 25 miles of wire being required for 20 acres of ground. The effect sought appears to be the equivalent of a continuous, strong and penetrating sunshine on a glass-house system, but with the further advantage of ability to regulate the heat to a nicety.

Unique Electric Heating Application.—Electric heaters are used in order to prevent freezing of the water in a large roof tank which holds the supply of water for the fire sprinkler system of a New York city loft building. When the sprinkler system was put in experiments were made with electric heating, and it was found that heaters set in the 18-inch air chamber in the top of the tank, attached to the under side of the airtight cover, gave the best results. Accordingly four 1,200 watt heaters were installed, with thermostatic control to keep the temperature within the tank from falling below 34 deg. Fahr. During the severe weather of last winter the installation worked with perfect satisfaction, switching the current on and off automatically, and the tank was kept entirely free from ice.

Individual Electric Drive for Loom.—An English textile mill having 700 individual motor driven looms has shown 10 per cent increase of production and a saving of $40 for erecting and equipping owing to the lighter construction of the loom shed as compared with that required for a steam-driven plant. Additional advantages were the improvement of product, the clearer atmosphere, better light, and reduced risk for the operatives. Motors attaining 88.5 per cent efficiency were installed, giving loom efficiencies as high as 87 per cent even when tended by weavers who had had no previous experience with motor drive. The effect on profits worked out on a 10 per cent increase in production, was an increase of over 30 per cent.

Electricity from Highly Heated Carbon.—According to an article in the London *Electrician*, J. A. Harker has found that when two highly heated carbon electrodes are placed in the furnace at points of relatively different temperature, a flow of electric energy may be detected. By making one of the electrodes movable, he was able to produce a low frequency alternating current. This lead to the experiment of using two concentric electrodes, one of brass and the other of carbon. Water was passed through the brass tube to keep it cool. The tubes were insulated from each other, by passing hydrogen or nitrogen in the annular space between them. When the outer tube of carbon was heated, a flow of electricity took place. On examining the apparatus it was found that the brass tube was coated with a thick deposit of carbon from the heated electrode.

Navigation and the Eiffel Time Signals.—The sextant affords the navigator an accurate means of ascertaining his latitude, but for longitude he must depend on the chronometer, which cannot be made to run with absolute accuracy, making it necessary to use several of these instruments for checking purposes. The Eiffel Tower radio-telegraph station now dispatches diurnal time-signals enabling all chronometers within range to be checked. This service has been in continuous operation since May 23rd, 1910, mean Paris time being transmitted. Day signals at 11, 11:02 and 11:04 A. M. and night signals at 12, 12:02 and 12:04 A. M. are sent out, each consisting of a warning signal of dashes and dots, ceasing two or three seconds before the actual time report, which is a single dot. For determining differences of longitude in accurate cartographical work special arrangements serve to emit signals giving an accuracy of a few hundredths of a second.

New Electric Steel Furnace.—Dr. H. Nathusius has designed an electric steel furnace which seeks to combine the advantages of the Héroult and the Girod furnaces. The new apparatus is of the combined arc and resistance type, with three carbon electrodes penetrating vertically into the hearth compartment at the corners of an equilateral triangle. These electrodes are connected to the outside terminals of a three-phase generator or transformer, and three steel electrodes at the bottom of the furnace, also arranged at the corners of an equilateral triangle, are connected to the inside terminals of the generator or transformer. Thus the furnace charge itself forms the neutral point of the inductive circuit, and the connections provide for the concentration of currents within the mass of the charge, giving maximum economy of heating. Moreover, the rotating field set up in the molten steel causes whirlpools which in conjunction with the uniform heating give a very thorough mixing, and therefore perfect uniformity of the finished product.

Movable searchlight.

Coast-Defenses of the United States

The System of Range-Finding by Which the Great Accuracy of Coast-Defense Gun-Fire is Secured

Range-finding tower.

THE system of coast-defense fortifications which protects the maritime cities, harbors, and important waterways of the United States proper is probably the most extensive and complete in existence. It was planned in 1886 by a special army board, known as the Endicott Board, and, after two decades of continuous construction, it may now be considered as practically complete. The total cost of the work to date is $140,000,000. It includes at present 388 12-inch mortars, 113 12-inch guns, 136 10-inch, 74 8-inch, and 531 guns of smaller calibers than 8-inch. Also there are yet to be mounted in the various batteries two 16-inch guns, 164 12-inch mortars, 31 14-inch, 45 12-inch, and 98 guns of calibers less than 8-inch. A single one of the 12-inch guns costs $49,000, and hence the one hundred and thirteen guns of this caliber, alone, represent an expenditure of some $5,537,000.

Every time a 12-inch gun is fired with an armor-piercing, high explosive shell it costs the country $600. Furthermore, the accuracy-life of the latest and most improved of these guns (that is, the number of rounds that can be fired before the rifling becomes sufficiently worn to affect the accuracy) is only about 250 rounds. Hence it can be seen that accuracy of fire is a prime consideration. It is probable that only a very small proportion of the taxpayers of the country have any idea of the means by which these costly coast-defense guns are fired and accuracy of aim secured. To make this clear is the purpose of the present article.

Let us suppose that the enemy is making a night attack in column, or line ahead. We will suppose the night is dark but clear. The powerful searchlights of the defense, sweeping the channel, pick up the leading ship. Instantly the battle commander sounds the "call to arms." The attack is expected and the men are sleeping at the guns. Within a few seconds every man is at his post. The battle commander, by telephone, notifies the fire commanders of the approach of the enemy, and, the night being fine, he is probably "picked up" at about 10,000 yards. When the fleet attacked is in column formation (i. e., the ships following one another in a single line) the modern plan of attack is to concentrate all available guns on the leading ship, so as to quickly cripple it and throw the line into disorder. Hence all the heavy rifles (12-inch and 10-inch) and the mortars would be directed on the head of the line, the high velocity guns doing their damage upon the belt and turret armor, the mortars attacking the decks.

But we are anticipating. Although the searchlights have found the ship, the distance is not known. This is determined by triangulation. If we know any two angles of a triangle and the length of the side between them, we can determine the length of the other side (in this case the distance to the ship). In our coast-defense two systems of triangulation are used, the horizontal and the vertical. In the first, a long base line, one mile or more in length if desired, is measured and at each end an instrument with transit features is placed in a sheltered position. The observers at each station simultaneously train their instruments on the ship, and the angles subtended between the ship and the base line are telephoned to the plotting room, which is located in some sheltered position beyond the reach of the enemy's shells.

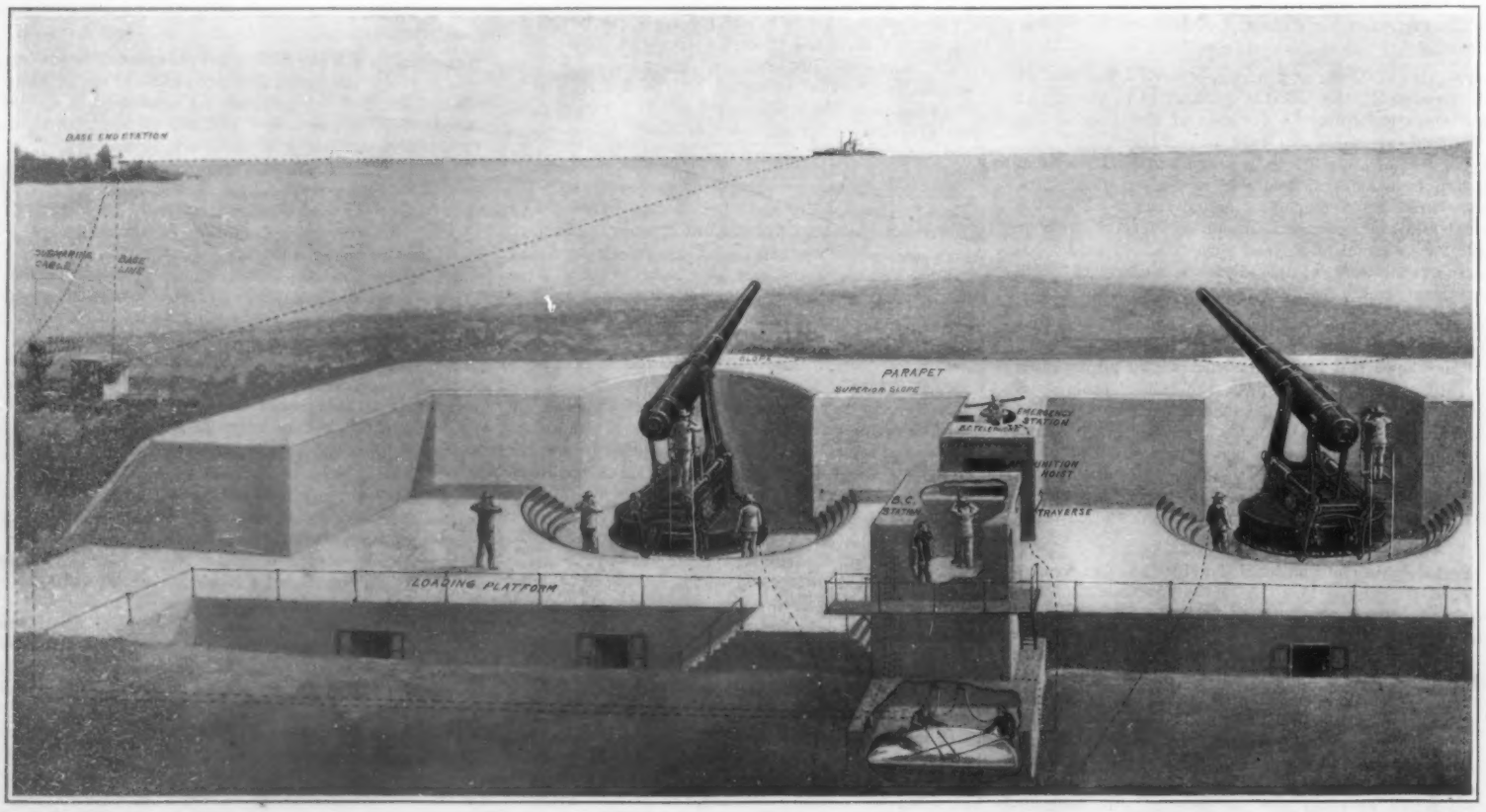
In the plotting room is a large draughting board, one edge of which is semi-circular and graduated in degrees and hundredths of a degree. Upon the board are pivoted two straight-edges, which are set at the observed angles sent in by telephone from the observing stations at each end of the base line. The point of intersection of these straight-edges gives the exact position of the ship, the distance of which from the battery is read off by a scale in yards. It would not be sufficient merely to elevate the gun to an angle corresponding to the range as thus determined. The following sources of error must be considered and corrections therefor applied: 1. The accelerating or retarding effect of the wind. 2. Variation of height of gun above water level due to tide. 3. Variation of air resistance due to its density. 4. Variation of energy of powder due to temperature. 5. The ever-changing position of the ship, causing a change of range.

Now it is evident that no time can be spared for working out these calculations mathematically. They must be applied to the range with lightning-like rapidity; and this is done by means of some very clever automatic mechanical devices, which are installed in the different plotting rooms of the fortifications.

The final deflection to be set on the gun-sight is the algebraic sum of the component of the wind, the drift (tendency of the shell, due to rotation, to move out of its path horizontally) and the movement of the ship during the flight of the shell from the gun to the ship. This is instantly calculated by the above-mentioned device in the plotting room.

Now let us go back to the observers at the end of the mile-long base line. Each observer is keeping his telescope on the ship, now clearly visible in the night under the concentrated beams of the searchlights. Simultaneously a bell is rung in each station, and instantly the observers read the angles and telephone them to the plotting room, where they are at once plotted on the board and the distance of the ship from the gun is determined. After thirty seconds interval, during which the ship has moved a certain distance on her course, the bell again rings, the angles are again sighted and telephoned in, and the position of the ship is again plotted. The distance between the two plotted positions is scaled off on the board, and since this has been covered in thirty seconds, the speed of the ship and her course are now known.

The last range, as thus determined, is set on what is known as the range board—a graphic adding and subtracting machine. On this machine the corrections for wind, drift, tide, etc., above referred to are applied



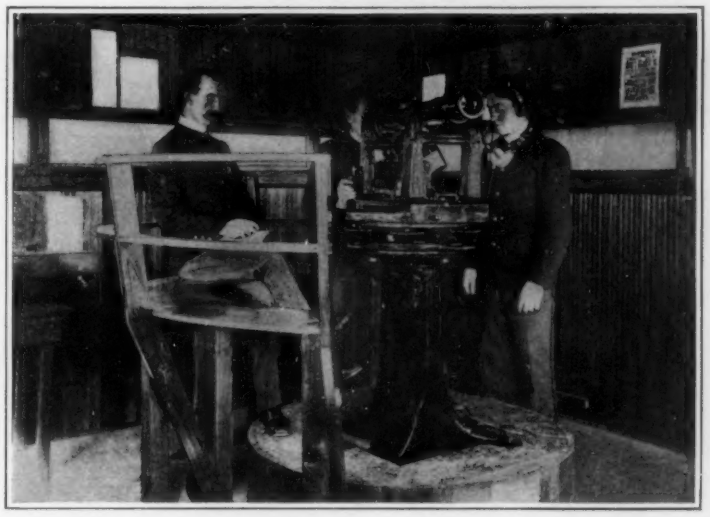
Observers at Stations B¹ and B², which may be a mile or more apart, note the angles made by the lines to enemy's ship and the base line. These angles are telephoned to the plotting room, where the exact position of the ship and the corresponding elevation for the guns is determined. This elevation corrected for wind, tide, etc., is telephoned to the guns.

Typical view of a coast-defense battery.

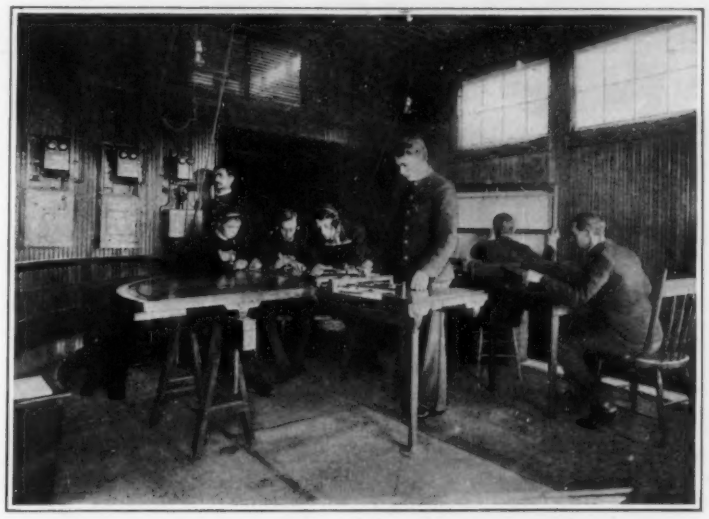
and the final resultant correction is instantly read off. This range, known as the corrected range to the target, is sent to the gun by telephone or telegraph. It is predicted for an interval of fifteen or thirty seconds ahead. It is now plugged on the time-range relation board, which is in full view of the range keeper at the gun. The range keeper keeps the range disk continually set at the corrected range (as observed on the time range relation board) so that the gun can be fired at any time. The deflection correction is obtained by the use of a device called the deflection board. This, as in the case of the range board, is an adding and subtracting machine which determines the number of degrees and hundredths of a degree of deflection due to wind, drift, and speed of target to be set on the sight. The drift is determined by ballistic calculations, and the curve is constructed on a metal leaf on the board. The velocity of the wind is determined at the meteorological station by means of an anemometer, and is received at the plotting room by means of an electrical device called the aeroscope. The direction of the wind is also sent by the same means. The components in the direction of range and deflection are determined by means of a device called the wind-component indicator. The atmosphere correction is determined in the meteorological station, and is sent in over the aeroscope. The height of tide is determined by a tide gage. The velocity correction is determined by a device called the powder chart.

Owing to the fact that these corrections may be either additive or subtractive, and that the use therefore of a negative sign tends to confuse the gunners in the plotting room, these corrections to be applied to the range are not sent in according to their actual values, but by means of reference numbers. The zero of the sight, for example, is the number 3. The gunner at the sight, therefore, would receive a deflection like this: 4.25. He simply sets his sight to read this deflection, and the gun will then be correctly aimed. It is to be understood that all these fire-control instruments and stations are located at obscure places in the fort reservation, and are amply protected by parapets of earth and concrete. They are connected with each other by either telephone, telautograph, or speaking tube, all of which are laid underground, deep enough to insure ample protection from ordinary gun fire.

The above description refers to the horizontal-base system of range finding. Of late years much attention has been given to the development of a satisfactory system of vertical-base range finding. This type, as worked out by Col. I. N. Lewis, of our Coast Artillery Service, and adopted as the standard instrument in coast-defense, is known as a "depression finder." It is mounted on an elevation of known height above sea level, and the angle at the instrument is found by directing the telescope upon the distant ship. The vertical height above sea level, representing the base of the triangle, is known, and the angle formed by the vertical and the horizontal line to the ship at sea level is ninety degrees. These data, modified by corrections for tide, earth's curvature and atmospheric refraction, enable the other side of the angle to be computed, thus giving the exact distance to (range of) the ship.



Reading the ranges in room at the top of the range tower. Telescope is depressed until cross hairs are on the ship, when the range is read off on a scale.



The plotting-board detail at work determining the position of a ship from observations sent in from stations at ends of base line.

The depression finder has the great advantage that, when the preliminary adjustments for the above corrections have been made, the instrument, provided the cross-hairs of the telescope are on the ship, automatically records the range in yards. The elevation or depression of the telescope operates certain gears underneath the base plate, which move a pointer on a disk which is graduated to yards of range. Hence the instrument is self-contained, performing automatically and instantly the calculations which, in the horizontal base method, must be done on the plotting board in the plotting room.

The present general practice is to combine both systems in one, installing depression instruments in the stations at the ends of the horizontal base line, so that these stations can send in to the plotting room either the range or the bearing of the ship, at thirty-second intervals, if necessary.

The fire-control system is very flexible; not only can range be found by horizontal-base computations, or by the individual depression finders; but should all the range finders except that of the fire commander be destroyed, his own station can supply the necessary data for firing the various guns. Further than this, if all the stations, including the fire commander's, should be put out of action, there are emergency range finders installed on the flank of each battery. This range finder is of the 9-foot, self-contained horizontal-base type. This is the type which is used in the United States fleet. In case these are put out of action, ranges must be determined by means of buoys or from observation of fire.

The firing of mortars is far more difficult than that of guns. The mortars are completely concealed in deep, concrete-lined pits. Each pit contains four mortars and the pits are arranged in groups of four. Mortar attack is directed against the decks of the ships. The shells are thrown miles into the air and descend almost vertically upon the enemy, who is without any clue to the location of the concealed batteries. They are set for elevation in practically the same manner as guns, scales graduated in degrees and minutes being used instead of range scales; but their direction, instead of being set on sights, is accomplished by laying the mortar on an azimuth circle. In other words, the mortar is set for an elevation corresponding to the range, at an angle of direction equal to the azimuth of a predicted position of the target corrected for wind, drift, travel, etc. In past years many authorities considered mortars to be so inaccurate as not to authorize their construction; but within recent years the results of tests and the records of target practice have shown that they are of immense value to seacoast fortifications. Several companies in our coast artillery have made as high as 100 per cent of hits at ranges of six and seven thousand yards, when firing on a moving target having a speed of seven or eight miles an hour, and they have done this when firing but one mortar at a time. Mortars have a particularly great value in repelling a reconnoissance in force, as they can be fired with impunity without disclosing their location.

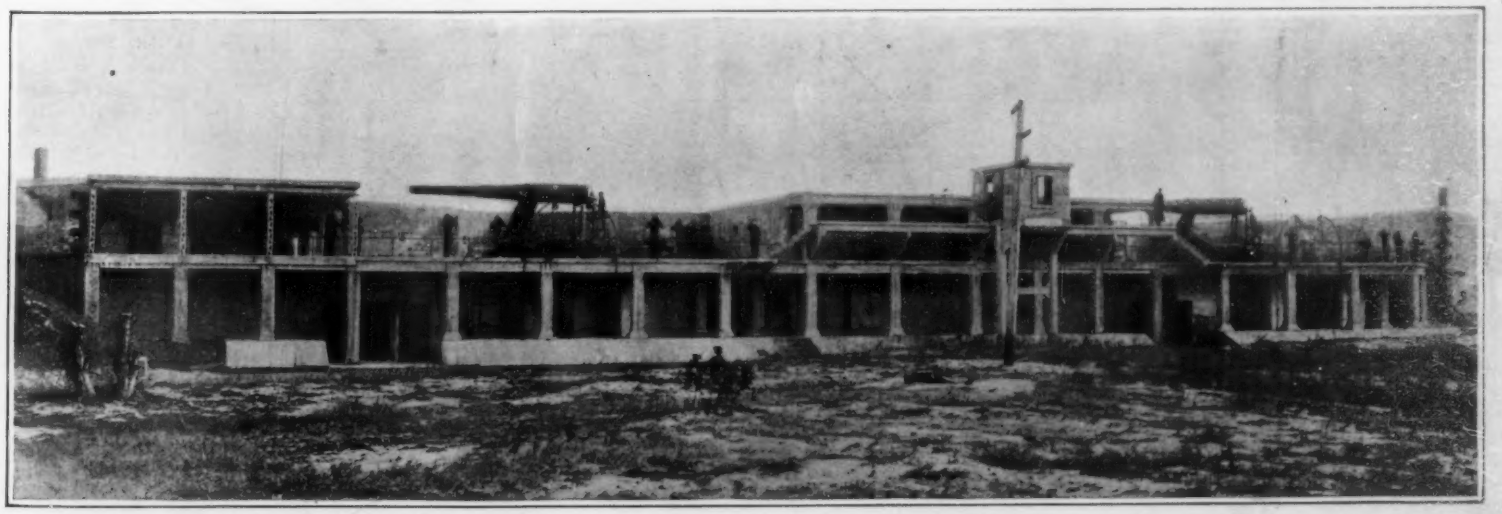
Such are the methods of locating a hostile ship, determining her distance from the gun, and calculating the proper elevations and direction of the gun to insure its projectile reaching the mark.

How does it all work out in practice?

We cannot do better than quote a former contributor, Capt. J. F. Howells, of the Coast Artillery, who gives the following facts in answer to the question, "What results may we expect from the guns that defend our outer harbors?"

First as regards the mortars. In moving from a range of 10,000 yards into one of 4,000 a squadron or fleet would be annihilated by mortar fire alone, in at-

(Concluded on page 490.)



Both guns, loaded, have been elevated to the firing position. The lanyard is about to be pulled. Note the gun detachments with their fingers to their ears.

Rear view of a battery of two 12-inch guns at Sandy Hook.

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The gun is beginning to sink below the parapet. The black cloud consists of the smoke of the ignition charge of black powder and a large amount of sand sucked up from the ground.

Discharge of a 12-inch gun at Sandy Hook.

Guns of the Coast-Defense

The Weapons Which Guard Our Roadsteads and Harbors

THE first line of the defenses of the United States is the navy, and of the navy the most important defensive element is our fleet of twenty battleships. The most effective protection is that which is offensively defensive—hence our battleships are provided with large coal capacity to enable them to carry the fight to the enemy's coastline. If our fleet should prove to be too weak for distant operations, its work would have to be confined to home waters; and should the enemy be in sufficient strength to crush all opposition on the high seas, forcing the remnant of our ships to take refuge within friendly harbors and roadsteads—then the defense of the country against naval attack would devolve upon the sea-coast fortifications.

By far the most important weapons of coast-defense are the heavy rifled gun and the mortar. Contemporaneously with the construction of the massive concrete fortifications by the corps of engineers, the ordnance department of the army has been developing and building the necessary guns and their mountings.

There are three principal systems of gun mounting recognized throughout the world. First, the barbette mount, a simple and strong construction which carries the gun at such an elevation that it is always visible above the parapet, and both the gun and the gunners are exposed to the enemy's direct fire; second, the turret mount, in which the gun and its carriage are inclosed within heavy protective armor, both being visible to the enemy; third, the disappearing mount, in which the gun is loaded and aimed below the parapet, and rises above the parapet only for the few seconds necessary for its discharge—the gun and its mount being, therefore, invisible.

The turret mount is used exclusively in the navies of the world, and it is the favorite mount in the sea-coast defenses of Europe. Moreover, it has lately been adopted for mounting our new 14-inch gun in certain special fortifications at Manila, P. I. It has the advantage of offering great protection to the gun, its mount and the gun crew; but it has the disadvantage, compared with the disappearing mount, that it is at all times visible to the enemy.

The disappearing mount has the great advantage, as its name implies, that it is invisible. Except at the instant of firing, the gun and its carriage are snugly nested behind a massive concrete wall, 30 feet or more in thickness, the front of which is backed up with a gradually-sloping mass of grass-covered earth or sand. This construction is so artfully done that, looked at from a range of several miles at sea, the battery is invisible, the grass-covered, sloping glacis in front of the parapet merging into the natural landscape back of the fortifications and rendering the determination of the exact location of the guns extremely difficult.

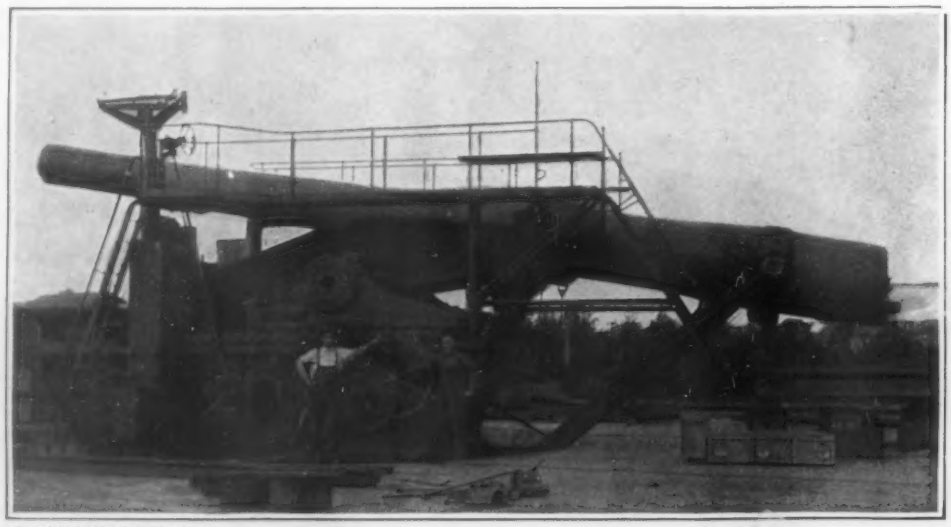
The disappearing gun carries no armor whatsoever. Dependence for protection is placed upon the fact that, when the gun is in the loading (depressed) position, it is so far below the parapet that even shells which just cleared the parapet would pass clear of the gun and the gunners. The disadvantage of this form of mount is the fact that high-explosive shells, bursting on the parapet, might shower a mass of débris (concrete, sand, and shell fragments) down upon the unprotected mechanism of the gun, putting it temporarily or permanently out of action.

Before determining what system of fortification to adopt, a thorough investigation was made of the various coast-defenses of European nations, and it was finally decided to equip the whole chain of fortifications called for by the Endicott Board with what is known as the Buffington-Crozier disappearing gun carriage. This has been done. We present an illustration of the new 14-inch gun, mounted upon the latest carriage of this type.

The original plans of the Endicott Board called for the mounting of eighteen enormous guns of 16-inch bore at New York, ten at San Francisco, eight at Boston, and four at Hampton Roads. The first trial gun of this type was completed and tested in 1903, the test taking place at Sandy Hook. During the construction of the gun, which occupied several years, there had been great advances made in the development of guns and powder, and particularly of the latter; and the 12-inch gun had been so much improved in velocity and energy of fire that by the time the big 16-inch piece was completed, the improved 12-inch piece was thought to be, all things considered, a more serviceable weapon

Table Comparing the Most Powerful Guns.

Type of gun.	Bore in inches.	Total length in feet.	Weight in tons.	Weight of projectile in pounds.	Weight of powder in pounds.	Kind of powder.	Muzzle velocity in feet per s.co.d.	Muzzle energy in foot-tons.	Muzzle energy in foot-tons per ton weight of gun.
Armstrong	16.25	43.5	110.5	1,800	960	Slow-burning cocoa	2,087	54,390	492
U. S. army	16.00	49.7	130.0	2,400	640	Nitro-cellulose smokeless	2,306	88,000	677
U. S. army	14.00	48.0	61.0	1,660	340	Nitro-cellulose	2,250	58,300	956
U. S. navy	14.00	53.0	63.3	1,400	370	Nitro-cellulose	2,600	65,687	1,037
U. S. army	12.00	42.0	59.1	1,046	367	Nitro-cellulose	2,500	45,300	767



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Total length, 48 feet; weight, 61 tons; weight of shell, 1660 pounds; weight of powder, 340 pounds; muzzle velocity, 2,250 feet per second; muzzle energy, 58,300 tons; energy per ton-weight of gun, 956 foot-tons.

The new 14-inch gun (disappearing mount). This piece will be used at Panama and in the Philippines.

for coast-defense. The 16-inch gun is very costly and takes an unconscionable time to build; its rate of fire is slow (one round in two minutes); the cost of each round is excessive, and the chances of hitting the target are only slightly better than with the cheaper, more rapid and less costly 12-inch gun. True, when a hit is made the damage to the enemy is far greater; but gun for gun the chances of hits in a given time are four to one in favor of the 12-inch piece. For these reasons the construction of the 16-inch guns was discontinued.

Attention is drawn to the accompanying table giving the particulars of the most powerful guns of the present time. It will be noted that the Armstrong gun (now practically obsolete, having been built some 20 years ago) is the only piece which compares in weight and caliber with the 16-inch coast-defense gun. Comparing the two guns, then, we find that the 16-inch gun is 6 feet longer over all and 19½ tons heavier; that its projectile is 600 pounds heavier; that because of the better quality of powder that has been developed during the intervening twenty years since the Armstrong gun was built, the 16-inch gun requires only 640 as against 960 pounds of powder for a full charge, but that with this smaller charge the heavier projectile is propelled with a velocity greater by 219 feet per second, giving a muzzle energy greater by 33,610 foot-tons. The direct test, however, of the relative efficiency of the two guns is the amount of energy developed per ton-weight of the gun itself, and this for the Armstrong gun of 1887 is 492 foot-tons, and for the United States 16-inch gun 677 foot-tons.

For several years succeeding the abandonment of 16-inch gun construction, the 12-inch piece remained the standard heavy piece for coast-defense. During this time much attention was being given to the very serious question of gun erosion—the wearing away of the bore of the gun, due chiefly to the extremely high pressure and consequent high temperature developed by the powder gases. These high temperatures were due to the high pressures which are necessary to secure the great velocities which characterize modern ordnance.

Some years ago the ordnance department announced that, with a view to reducing erosion and so prolonging the life of the guns, it was designing a 14-inch gun, which would have the low velocity of 2,150 feet per second, as against the 2,500 feet per second developed by the 12-inch gun, and would fire a projectile of 1,660 pounds weight as against the 1,046-pound projectile used in the 12-inch gun. It was announced that the lowering of pressures thus made possible would result in raising the accuracy life of the 14-inch gun to 250 rounds, as compared with a life of less than 100 rounds for the existing 12-inch gun.

The advantages of the 14-inch gun are: First, a longer endurance; second, an increase in the bursting charge within the shell of 50 per cent.

The disadvantages are: First, a smaller penetration than the 12-inch at all ranges up to 9,000 yards, when it is equal for both guns, the penetration at ranges beyond this being greater for the 14-inch gun; second, the danger space within which a vessel will be hit is greater for the 12-inch gun, being 70 yards greater at 3,000 yards, the difference in its favor decreasing as the range increases.

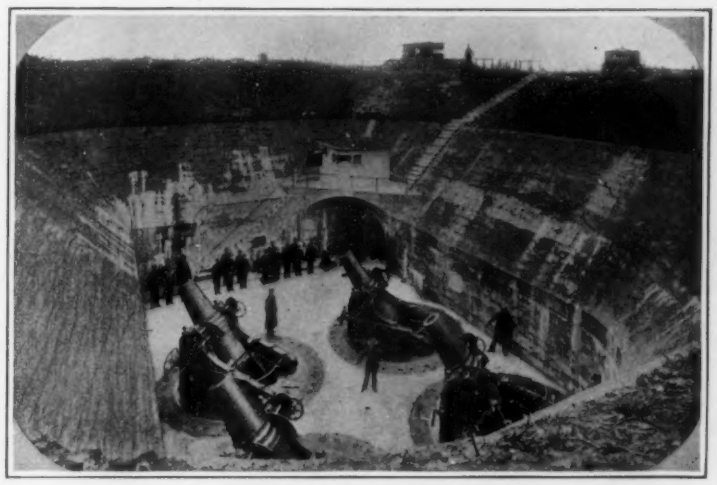
The above comparison is between the 12-inch with 2,500 foot-seconds and the earlier pattern 14-inch with 2,150 foot-seconds initial velocity. The later 14-inch pattern has 2,250 foot-seconds; and though this means, of course, a corresponding reduction of the accuracy life, the penetration, danger space, and other ballistic properties are proportionately improved.

One illustration of the 14-inch gun shows the piece mounted upon the latest pattern of Buffington-Crozier disappearing carriage. In this mount the gun is pivoted at one end of a pair of massive levers, at the other end of which is suspended a weight which is sufficient, after the gun is loaded, to bring it into battery above the parapet. The gun is brought back and down to the loading position by the energy of the recoil. While in the loading position, it is entirely below the parapet, and both the gun and the gun detachment are protected from direct fire. The ammunition is kept in massive concrete ammunition rooms. The sighting of the gun is done while it is in the depressed position. At the word of command a catch is released, and the heavy counter-weights bring the gun into battery above the parapets. This disappearing mount is used for the 14-, 12-, 10-, 8-, and 6-inch guns.

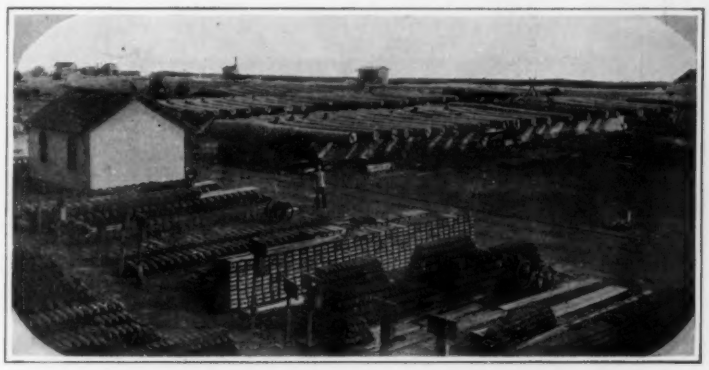
A typical battery command, as elsewhere illustrated, consists of two guns, mounted on a massive concrete platform behind a concrete parapet 30 feet thick, the front of the parapet being further protected by an even thicker bank of sand. Beneath the loading platform, deep in the mass of concrete, are the ammunition supplies, which are loaded on to an endless traveling chain hoist, which brings the powder and shell up to a delivery table upon the loading platform, from which it is wheeled on trucks to the breech of the gun. The 12-inch gun can be loaded, aimed and fired twice every minute.

In the typical view shown, the battery commander's station is in the upper floor

(Concluded on page 449.)

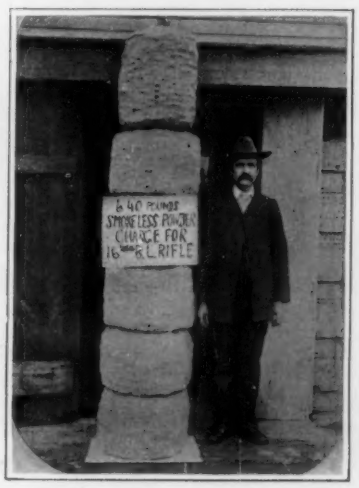


Concealed battery of four 12-inch mortars.

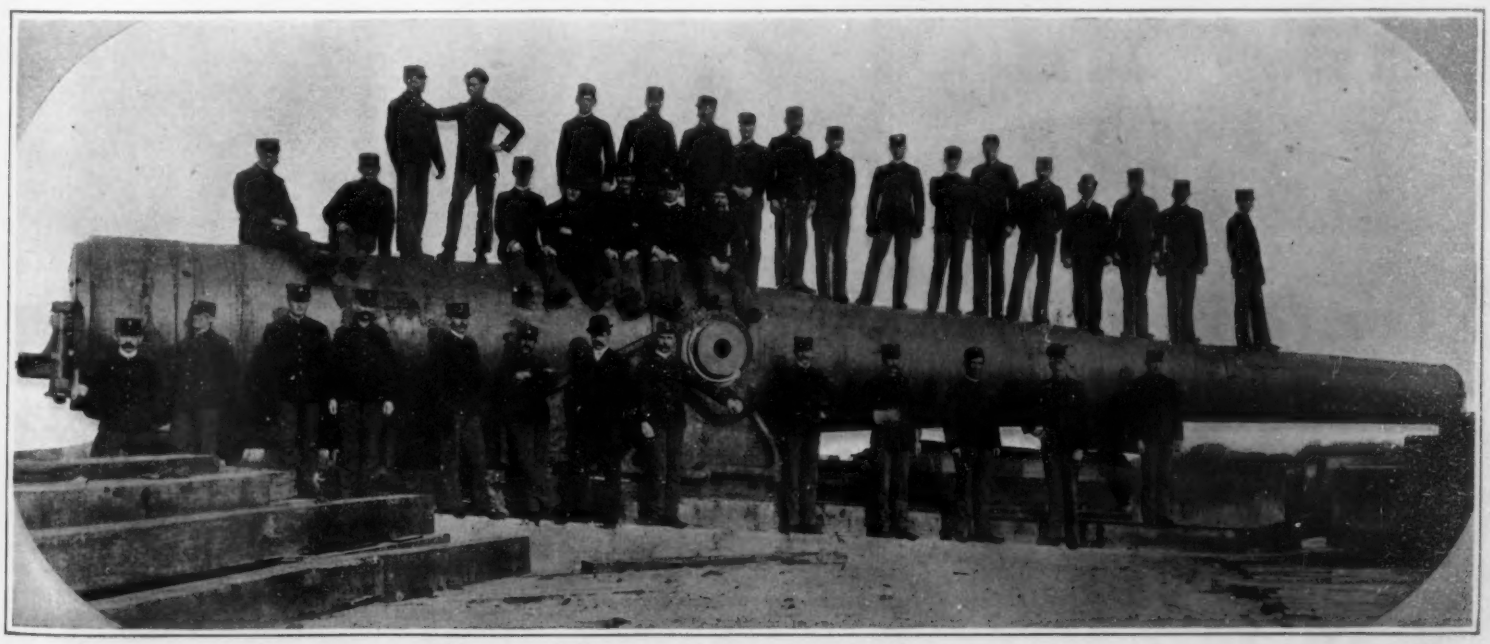


Reserve 10 and 12-inch guns and shells at a proving ground.

A 2,400-pound shell for the 16-inch gun.



The 640 pounds of smokeless powder used in a single discharge.



Total length, 49.7 feet; weight, 130 tons; projectile, 2,400 pounds; muzzle velocity, 2,306 feet per second; muzzle energy, 88,000 foot-tons.

The 16-inch army gun.—The most powerful weapon in existence.

Twelve-inch, high explosive shell, suspended below surface and exploded near caisson to determine effect on hull of battleship.

Gun Versus Armor

How the Gun Won the Contest Between Projectile and Armor-plate

THERE is a touch of the dramatic in the story of the contest between the gun and the armor-plate, or a touch of the comic, if you will, calling to mind the classic conundrum involving an "irresistible body" meeting an "immovable post." The story is as old as history itself. The modern shell has its prototypes in the slinger's stone, the arrow, and the spear, and the plate was foreshadowed in the coat of woven grass, the leathern shield, and the metal breast-plate.

For the beginnings of the modern chapter of this story we must go back more than half a century to the period of the Crimean war, and the time of Napoleon III., when the French laid upon the sides of their wooden battleships a few inches of iron plating, which proved to be quite sufficient to keep out the low-velocity shot and shell that rained upon it from the Russian guns. A few years later, in the many memorable contests of our Civil War, the armor more than held its own against the gun, and it was the invulnerability shown by the "Monitor" and "Merrimac" in their famous duel that started the gun manufacturers on that quest of a weapon which should be irresistible by any defensive armor that could be fabricated. Today the victory lies with the gun; for it is the boast of the gun maker that his latest product can perforate the best armor at any range at which the target is visible—a boast which is amply vindicated by the photographs of clearly perforated plates which are shown on page 443.

It is impossible, within the limits of the present article, to elaborate the history of this contest between gun and armor; it must suffice to describe the present state of the art and give some of the latest and most significant results obtained at the proving-ground.

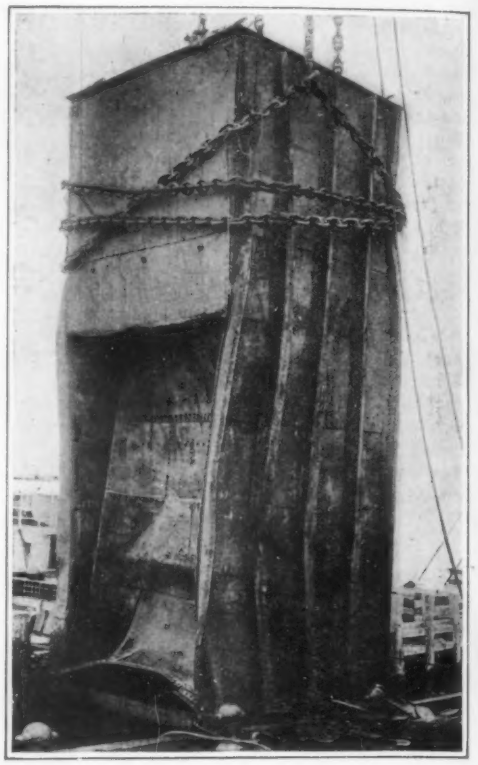
We have shown, in another chapter, that the 16-inch gun delivers its 2,400-pound shell with an energy, as it leaves the muzzle, of 88,000 foot-tons, or sufficient to lift the 20,000-ton "North Dakota" bodily over four feet into the air. Now when the projectile strikes the plate, the whole of this energy is concentrated in the comparatively small mass of metal at the point, which must be made sufficiently hard and tough to hold together until it has broken through the diamond-hard face of the plate, and opened the way for the whole mass of the shell to bore its way through 12 to 18 inches of the hardest and toughest steel that the ingenuity of man has been able to produce.

Modern shells are formed with a cavity—this is done partly to enable the shell to be so treated in manufacture that the initial strains can be removed, and, partly to provide for a bursting charge of high explosive, without which the destructive effects of a successful penetration would be comparatively limited. The widely-spread destruction wrought by the many fragments of a bursting shell is immeasurably greater than the purely local damage inflicted by a single solid projectile. It is conceivable that a 12-inch projectile, after penetrating the side armor of a ship, might pass through an engine room without breaking more than a single and relatively unimportant part of the main engines or the auxiliaries. But if that same shell were filled with high explosive, whose successful detonation transformed the shell into the mass of flying fragments big and little, shown in the accompanying illustration, it would mean the wrecking of cylinders, the cutting of steam pipes, and the fracture or bending of piston rods and valve stems, to say nothing of the disablement of a large percentage of the engineer force.

The problem, then, is to make the armor-piercing shell so hard and tough that it will, itself unbroken, pass through the hard face and tougher back of the plate, and to provide means, carried within the shell, whereby, when once inside the ship, and within a fraction of a second after contact, the high explosive will be detonated and the fragments of the shell hurled in all directions.

Armor-piercing shells are forged from steel alloys, the composition of which varies according to the preferences of the various makers. The addition of a small quantity of chromium, tungsten or other metal is made, chiefly to give the toughness which, with hardness, is an all-important element in the shell. The shell is then thoroughly forged, annealed to remove all internal strains, and tempered to a hardness such that a fragment of the point will cut glass.

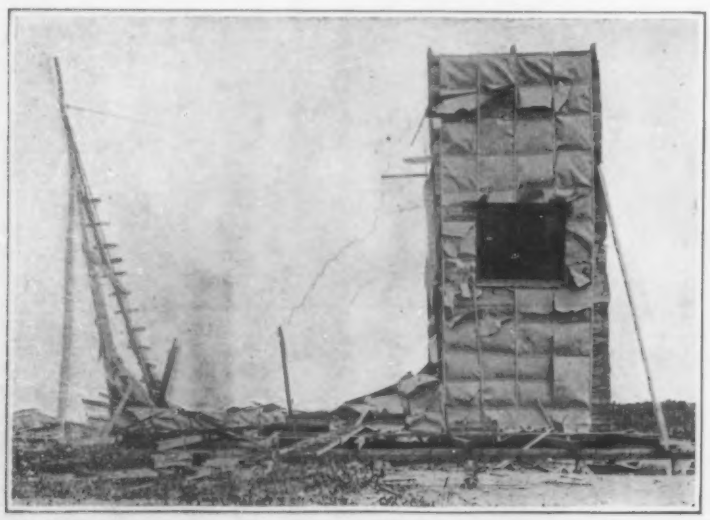
The bursting of the shell at the proper instant of time is done by a most ingenious contrivance, known as the delayed-action fuse. This consists of a hollow plug, screwed into the base of the shell, containing a hammer which is held at the base of the plug by springs. At its forward end the plug carries a primer and bursting charge. The shock of the shell striking the armor releases the hammer, which flies forward by its own inertia; and the distance from the hammer to the primer is so adjusted that the primer will not be struck nor the shell exploded, until the latter has passed through the armor and is just within the interior of the ship.



If a 12-inch, high-explosive shell falls short, enters the water and explodes near hull below the belt it will have effects like this.

Another form of projectile is the common shell, in which the cavity is larger and the fuse more sensitive, bursting the charge at the instant of contact. This type is used against the unarmored portions of the ship, the thin side plating providing sufficient resistance to cause the shell to burst, scattering the fragments in a wide swath of destruction.

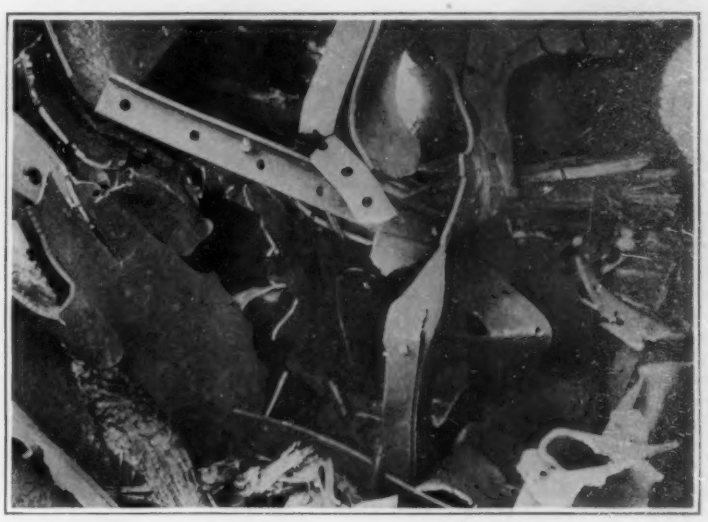
Shrapnel, which is used mainly by field artillery consists of a central cylindrical case filled with balls or bullets, and a head carrying a fuse which may be set to explode the shell either on contact or at any point in its flight. The base of the case is cored out to form a powder chamber. The percussion fuse explodes the shell by the striking of a plunger upon a primer upon impact of the shell. The time fuse is operated by the action of a train of prepared powder, which is ignited by the firing of the gun and reaches the exploding charge in the base of the shell at a predetermined time after the shell has left the gun. The bursting of this charge drives out the balls, which fly forward in an ever-dispersing shower and with a velocity due to the velocity of the shell plus the velocity due to the explosion. How deadly well aimed and well timed shrapnel would be against an exposed body of men may be judged from the accompanying illustrations of tests of shrapnel carried out at the Sandy Hook proving



This target, consisting of a frame of scantling covered with wood sheathing, originally carried three plates of steel.

One of the steel plates after a 12-inch shrapnel shell had burst, perforating it with a shower of bullets.

A Krupp plate, 11½ inches thick, after penetration by three, 12-inch, high-explosive, armor-piercing shells.



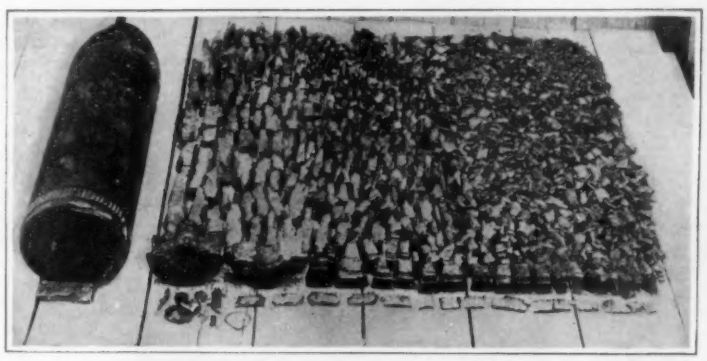
Rear of 11½-inch plate, showing how shell in bursting, tore the plating, representing a ship's framing, into shreds.

grounds. Most interesting is the story of the brave but ineffectual struggle of the armor-plate makers to produce an impenetrable plate. In earlier years it looked as though the impenetrable plate might be produced; but high velocity in the gun and improved metal in the projectile have proved too much, even for the wonderful face-hardened plates of to-day.

Before leaving the projectile, mention should be made of the soft cap, or nose, which is now used on all armor-piercing shells. At a time when face-hardened armor seemed to be too much for the shell—breaking up the point before the shell could develop its full penetrative energy—the artillerist tried the experiment of putting a nose of soft steel over the point. The device worked wonders, increasing the penetrative power by 20 to 25 per cent. The theory of its action is that the blow of the soft cap tends to bend in the face of the plate, throwing the surface metal into tension, and so far straining it that the hard point is able to force its way in without breaking up. Moreover, the cap tends to brace the point and hold it up to its work—the fused metal of the cap also acting somewhat as a lubricant as the shell bores its way through the plate.

Any sketch of the progress of armor-plate making would be incomplete that failed to make mention of the work of that indefatigable pioneer in engineering, John Stevens, of Hoboken, N. J. As early as 1841 he had proved that 4-inch wrought-iron armor would keep out the 9-inch spherical shell of that time. We have already referred to the French armored frigate "Gloire," built in 1854, which was protected by 4¾-inch iron plates.

The armor used in the civil war was built up of ½-inch plates strongly rivetted together. It kept out round shot, but was easily penetrated by the projectiles of the later rifled guns. Then, as soon as our mills were equal to the task, we rolled the armor in solid plates, and this proved efficient until the Palliser shot, with its chilled and pointed head, proved its complete superiority. Then the armor-plate maker turned from iron to steel. The first steel armor was too brittle—it cracked and disintegrated, even when it broke up the shell. So it was decided to weld a hard steel face on a soft backing of iron, and the celebrated compound armor, which for many years was standard in the British navy, was produced. The same results were sought by oil-tempering the face of an all-steel plate. These plates successfully resisted the famous chilled, cast-iron Palliser projectiles. Then came the turn of the projectile makers. By alloying a small quantity of chromium with the steel, they succeeded in obtaining a complete victory over the plate. As an answer to this the armor-plate makers looked for some metal which would do for the plate what chromium had done for the shell, and they found it in nickel. A certain percentage of this metal, introduced into the molten steel before casting the ingot, so greatly increased the toughness of the plate, that it held together even when it was badly penetrated. In 1890 a series of celebrated tests were made at Annapolis of all-steel, compound, and nickel-steel plates, with the result that the United States adopted nickel steel as the material for all armor plate.



The minute fragmentations of a high-explosive shell. It is these fragments that do the terrible execution shown in the engraving above.

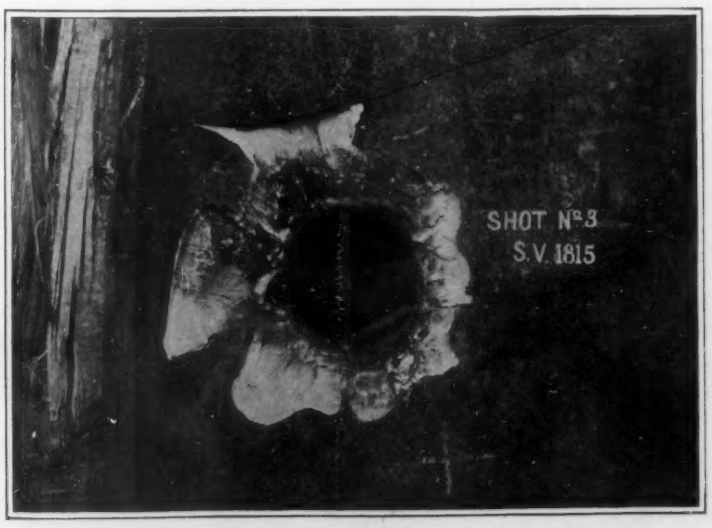
Next came Harvey with his wonderfully successful process of face-hardening, which achieved the same victory over the chrome-steel shell that the compound plate had over the Palliser shell—breaking up the point of the shell on impact. In the Harvey process the surface of the plate is super-carbonized by covering it with carbonaceous material and exposing the plate for a considerable length of time to high temperature in a furnace. When sufficient carbon has been taken up, the plate is removed and hardened by the application of cold water.

Following along the lines of the Harvey improvement, Krupp substituted a gas treatment for the carbonaceous layer, and this, coupled with special forge and furnace treatment, enabled the celebrated German firm to produce a plate exceeding the Harvey plate in its resisting qualities by 20 to 25 per cent.

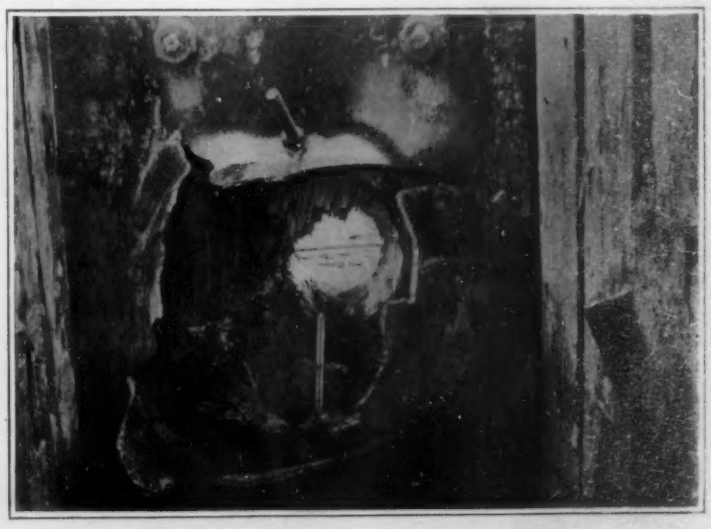
Meanwhile the projectile manufacturer had not been idle. Steadily the quality was improved, until to-day, in spite of the great increase in the velocity imparted by smokeless powder and the enormous increase (as the square of the velocity) in the energy, the best modern shells are able to develop on the plate all the energy which the gun can give them.

In proof of this we direct attention to the four remarkable illustrations at the top and bottom of this page. The first illustrations show the results of attacking an 11½-inch Krupp, face-hardened plate, representing, with its backing, a section from the side of the battleship "Iowa." The shells were loaded with dunnite, a high explosive used by our coast defense for the attack of armored ships, and they contained in the base the delayed-action fuse already described. Clean penetrations were made and the functioning of the fuse was perfect, the burst taking place, either in the plate, or just to the rear amid the steel framing representing the side of the

(Concluded on page 469.)



This plate of Krupp, face-hardened armor, 18 inches thick, was cleanly perforated by a 12-inch shell.



Rear view of the same 18-inch armor plate. Note the clean hole through the timber backing and the covering plate.

GUNS VERSUS ARMOR

Coast-Defense by Submarine Mines

The Most Speedily Prepared, the Most Deadly, and the Most Dreaded Form of Coast-Defense

LET us suppose that an enemy has eluded or destroyed the fleets of the United States, and that, in a furious and well directed attack by the 200 twelve-inch guns of a fleet of twenty dreadnought battleships, he has succeeded in locating and destroying the batteries defending the approach to one of our important maritime cities; and let us suppose, further, that, by an inconceivable coincidence of misfortunes, our hidden mortar batteries have failed to stop the onrush—what, we may ask, is to stay the attack and save the city from the option of bombardment or surrender?

We answer: The submarine mine, than which there is no more dreaded or destructive weapon to be found in the annals of coast-defense warfare.

Submarine mines are of three different kinds. 1. Observation mines, fired from shore, when a ship is judged to be within effective range of the explosion. 2. Automatic mines, which are self-firing when struck by a ship. 3. Electrical contact mines, which, on being struck by a ship, give notice to an operator on shore, who, by the throw of a switch, fires the mines.

A mine consists of a metal case, filled with high explosives, and fitted with a fuse that may be fired automatically, or at will by an operator located at some distant point. In shallow water the mine is laid on the bottom and is known as a ground mine. When the depth is so great as to interfere with the destructive force of the explosion, the explosive is carried in a buoyant cylinder or sphere, which is anchored to the bottom by a length of cable which causes it to float at the proper depth to be struck by a passing ship.

The type in general use to-day is the electro-contact mine. The mines are planted in rows across the channel to be defended, the mines in successive rows being "staggered," so that if a vessel should pass through the first row, it must inevitably strike one or more in the later rows. They are planted in what is known as "grand groups," which consist of 21 mines in groups of three. Some distance in the rear of the line of mines, there lies on the bottom of the channel a grand junction box, from which seven cables spread, each leading to a triple junction box, which in turn controls its small group of three mines. From the grand junction box, also, the multiple cable winds its way to the switchboard connection in the operating room on shore.

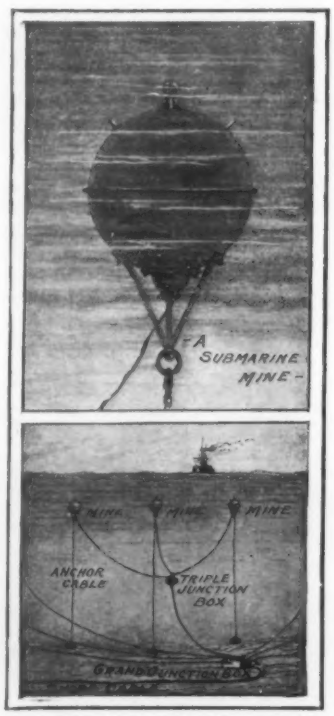
The grand junction box is placed at the center of the line of mines and about 100 feet to the rear. The triple junction boxes are laid in a straight line at intervals of 300 feet; from each of these boxes separate cables lead to each of three mines, the mines, twenty-one in all being spaced 100 feet apart, in a line which extends for two thousand feet across the channel. Each mine is anchored by a cable to an anchor, the length of the cables being such that each mine will float at a depth of ten or twelve feet below the surface of the water.

Now, it can readily be seen that since the modern warship is from 80 to nearly 100 feet in width, it would be impossible for an enemy's vessel to pass through two or three successive lines of mines, disposed as above, without coming in contact with at least two or three.

By an ingenious arrangement, one, three, or the whole grand group of mines can be fired, either from the operating room ashore, or by contact with a ship, all at the will of the operator. It is believed that for quick execution, reliability, and absolute destructive power, there is nothing equal to our Coast Defense Submarine Mine System of laying and operation.

No mine field is complete, or can ever be thoroughly effective, unless it is protected by rapid-fire guns. It is possible for small boats, launches, etc., to be sent forward ahead of the ships, and set off the mines by exploding large charges of dynamite in the mine field. If the mines are within the "sympathetic radius" of the explosions, they will be exploded by the shock. The most effective protection against such countermining, as it is called, is by flanking the field with batteries of rapid-fire guns.

The modern battleship costs, complete, from $10,000,000 to $12,000,000. One mine of the larger size, detonated against the ship in the wake of the magazines, might readily send her to the bottom in a few minutes' time. The moral effect of such a terrific agent of destruction as a modern mine field is compelling. It is very doubtful if any admiral, even if



This electro-contact mine contains 100 pounds of high explosive. It may be detonated either by contact with the ship, or by an operator in a concealed position on shore.

Submarine mine and details of wiring.

the enemy's batteries were silenced, would assume the responsibility of running his fleet into waters which were capable of being thoroughly mined.

The greatest exhibition of the deadly character of the mine was that afforded by the Russo-Japanese war, when the battleship "Petropavlovsk," of the Port Arthur fleet, and the battleships "Hatsuse" and "Shikishima" of the Japanese blockading fleet fell victims to its blow, the "Hatsuse" and "Petropavlovsk" sinking within a few minutes of being struck.

The loss of the "Hatsuse," as described to the writer by Captain (now Admiral) Von Essen, whose ship, the "Sevastopol," formed part of the Russian fleet in Port Arthur, will form a fitting close to the Coast-Defense Chapters of this present issue. The officers of the Port Arthur garrison had observed that the Japanese blockading fleet, as a precaution against torpedo attack, withdrew at night to a distant rendezvous, returning to observe the fortress by day. It was determined, by observation, that the fleet always cruised, at a distance of seven miles, on a course evidently laid between points on shore. The course was plotted by the Russians, who one night sent out their mining ship, and dropped three lines of mines at right angles to the sailing line, the ship returning to Port Arthur without being observed.

Before daybreak, next morning, a group of Russian officers, from the top of a high hill, watched with their glasses for the return of the fleet. Soon it was observed. In line ahead, with the 15,000-ton "Hatsuse" in the van, the Japanese headed for the harbor, turned, and settled down on the usual course. As they reached the mine field, the bearing of which was known to the Russians the subdued excitement among the group of observers became most acute. Suddenly, near the bows of the "Hatsuse" there arose an enormous column of smoke and water. The stricken ship at once dipped by the bows, and within less than two minutes, by Von Essen's reckoning, not a vestige of the ship was to be seen!

Evidently the mine, striking near the bows, had set off the forward magazine, tearing the ship apart and sending her at once to the bottom.

The Most Expensive Wood in the World

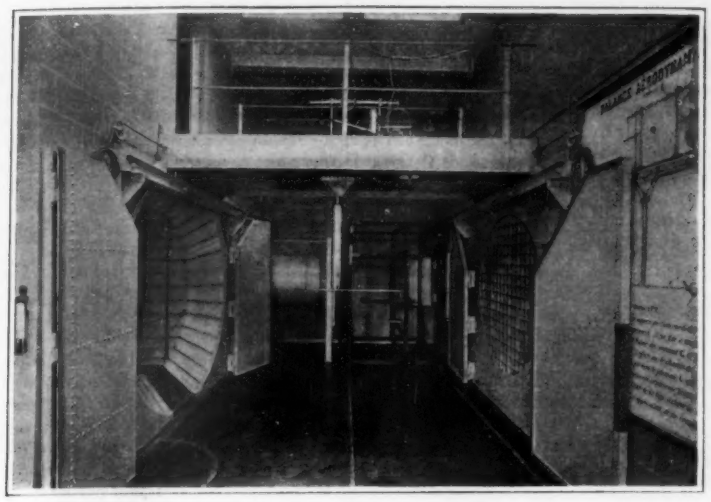
CABOLE (*Anisophyllea cabole* Henciq.) is the name of a beautiful tree belonging to the mangrove family of plants, *Rhizophoraceæ*. It is a native of the west coast of Africa, and is very common on the island of St. Thomas, where it is found generally in low or medium elevated portions. In the southern part of the island the tree grows so near the shore that its roots occasionally strike salt water. A more ideal situation is on the southern slopes of the mountains, where in its mature state it forms a very large tree. Individual specimens may be seen here and there which are from 120 to 140 feet high and from 4 to 7 feet in diameter 4 feet above the ground. Most of the trees are very much smaller, for the reason that practically all the mature trees have been cut down to make room for the cultivation of sugar cane. The large trees which are now to be found on these islands have been spared for the purpose of shade or wind break.

The wood, which is very highly esteemed, has a yellowish or light chestnut-brown color with darker colored streaks. It is very firm and durable, and when sawn into boards has the appearance of teak wood (*Tectona grandis* L.). It is easily worked and is susceptible to very high polish. When carefully filled and varnished it takes on a most beautiful appearance. The specific gravity of this wood is about 0.780 or 48.5 pounds per cubic foot. It is the most costly wood in the world, and is used at present only for making high-grade furniture and objects of luxury. This wood also serves as material for making fancy doors, parquetry, and interior finish of very fine residences.

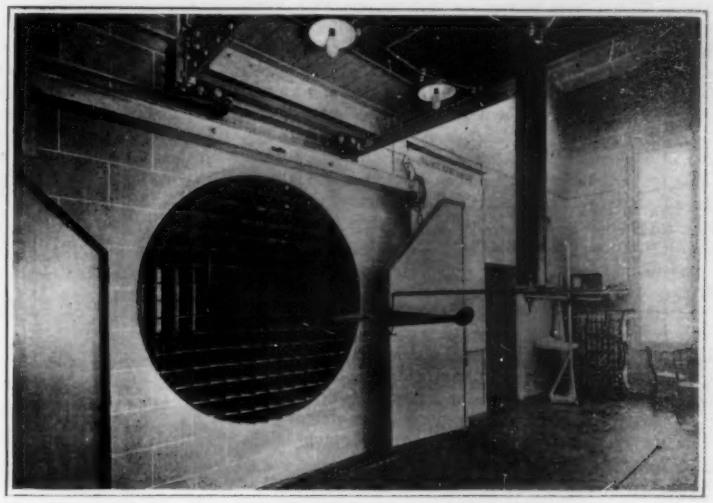
Cabole was first sold in the city of St. Thomas in 1885, and immediately became very popular for all sorts of fancy work. The first boards which were brought in the market were not sawn, but split with wedges. Several of the merchants in St. Thomas at once attempted to introduce this beautiful wood into the English and German markets, but the cost of preparing the logs for shipment was so great that the project failed. The wood retained its popularity in St. Thomas, and the price soon went up to about $3,500 per cubic meter. Cabole may, therefore, be considered the most expensive wood in the world.

This shows a "grand group" of twenty-one mines with its cable connecting to the firing station on shore. The mines are so anchored as to float at the proper depth to be struck by a passing ship.

System of mine laying for the United States coast-defense.



The experimental chamber, showing measuring apparatus above and model in place below.



Model of Nieuport monoplane mounted ready for a test. The air stream comes through the grating.

The New Eiffel Aerodynamic Laboratory at Auteuil

Description of the Plant, With Results Obtained in Eiffel's Experiments

THAT gifted and remarkable octogenarian, Gustave Eiffel, has just given fresh proof of his intellectual vigor and enterprise by the opening of a new laboratory at Auteuil, on March 19th, for the study of aerodynamic problems, with special reference to the practical needs of aviation.

The laboratory is an enlargement of and an improvement upon the one erected in 1905 at the foot of the Eiffel Tower in the Champ-de-Mars. Since the opening of the latter more than four thousand experiments and tests have been conducted; and it is to be expected that the new one will be equally fertile of results under the direction of the practical genius and scientific imagination of such a man as M. Eiffel.

The Champ-de-Mars laboratory was fitted up for a current of air drawn in by a suction blower and traversing an experiment chamber. This current was in the shape of a cylinder having a diameter of 1.5 meters, or 4.92 feet, and a maximum speed of 18 meters per second, or 40.36 miles per hour.

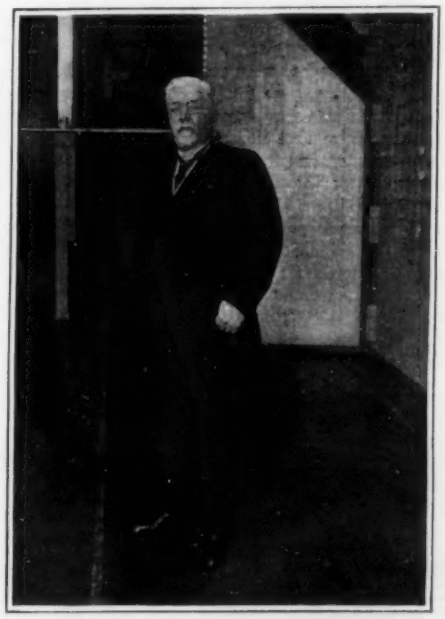
Before passing through this experiment chamber the air was drawn through a converging section of pipe called the collector, in which the speed increased progressively in the same ratio as the pressure diminished.

The blower used was a Sirocco blower of the centrifugal type; it absorbed a maximum of 50 horse-power.

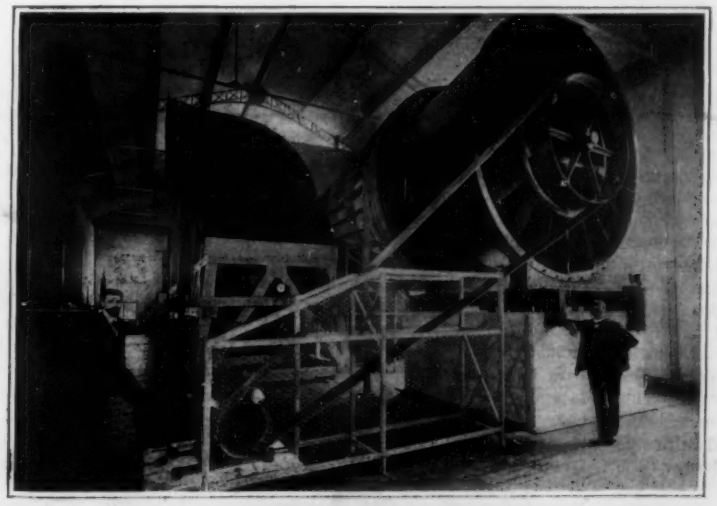
In the new laboratory at Auteuil (Rue Boileau 67, Paris) the main testing room is 98½ feet long by 43 feet wide, by 33 feet high, and the power has been so increased as to permit the production of an air current in excess of 70 miles per hour. In short, the net efficiency has been so increased that with a dynamo of a nominal 50 horse-power there has been obtained a cylinder of air 2 meters (6.56 feet) in diameter and having a maximum speed of 32 meters per second, or 71.41 miles per hour. If it be observed that the amount of kinetic energy communicated per second to this cylinder of air is not less than 6,450 kilogram-meters, or 86 horse-power, and that, moreover, the efficiency of the best blowers scarcely exceeds 50 per cent, the result obtained appears contrary to all expectation.[1]

This result has been obtained simply by interposing between the experiment chamber and the blower a diverging section of pipe forming a *diffusor*. This diffusor has a diameter of 2 meters at the exit from the experiment chamber, and it abuts upon the crown of a helicoidal blower having a diameter of 4 meters (13.12 feet) and providing for the passage of the air a utilizable section of 9 square meters, or 96.87 square feet. The reduction of speed produced in the passage through the diffusor by the progressive increase of the diameter reduces the pressure of the air a certain amount and correspondingly diminishes the work to be done by the blower in bringing the air to atmospheric pressure. The shape of the pipe from end to end is that of a Venturi tube, but the air is sucked through in the opposite direction to that in which it goes when drawn through the Venturi tube of a carbureter. The tests have demonstrated that the speed is very regular and may vary from 2 meters to 32 meters per second.

The accompanying photographs and drawing give a complete idea of this new installation. There is a smaller wind tunnel beside the first one, and in it a column of air one meter in diameter traverses the chamber at a speed of 40 meters per second, or 89.42 miles per hour. The blower is the same one that was used at the Champ-de-Mars laboratory. As heretofore, it is driven by a 50-horse-power motor. Thanks to the new arrangement adopted, the blower gives a useful effect measured by the kinetic energy of the air which passes per second through the experiment chamber, practically five times as great as at Champ-de-Mars.[2]



Mr. Gustave Eiffel standing in the experimental chamber of his new laboratory.



The suction blower at the end of the wind tunnel, driven by a 50 horse-power electric motor.

Before entering the experiment chamber the air passes through a rectangular grating at the mouth of the inlet tube for the purpose of producing a uniform current, which is likewise the object of using a suction blower instead of a pressure blower. The power is furnished by the monophase current of the Champs-Elysées sector, which is transformed into direct current by a convertor group.

The measuring apparatus in the experiment chamber is mounted on a rolling bridge or car, which permits of readily adjusting the model under test, and of moving it from one position to another. Obviously, it is necessary to firmly seal all openings not in use by means of solid iron doors.

The artificial current of air produced by this installation is the most powerful ever used up to the present time in aerodynamic laboratories. By the use of the controller on the electric motor the speed of the air current can be varied from 20 miles per hour to the maximum.

Of especial interest are the tests recently made upon the model of the Nieuport monoplane in such respects as stability, power required for varying speeds, and distribution of pressure and vacuum below and above the wings. The pressure tests showed that the peculiar wing section adopted by Nieuport produced a slight vacuum under certain portions of the leading edge of the wings, showing that the section employed was not of the highest possible efficiency, a fact corroborated by the testing of other sections.

The pressure distribution likewise indicated the desirability of rounded wing-ends to conform to the shape of the pressure contours.

Some of the other interesting results obtained in the Eiffel experiments are given herewith. The first of these worthy of mention is the fact that the efficiency of the wing of an aeroplane varies with the aspect ratio. The aspect ratio, it will be remembered, is the proportion of the width to the length of the wing or main plane. An aeroplane having an aspect ratio of six has been found to be a very efficient one. Such a machine has a wing spread equal to six times the width or chord. The aspect ratio of nine has been found to be the best, but the advantage gained by so high an aspect ratio is not great enough to make it worth while to design a machine having a spread greater than six times the width or chord of the wings.

The travel of the center of pressure of an aeroplane wing is another point which has been cleared up by the Eiffel experi-

[1] The formula is $\frac{\delta S V}{g} \times \frac{V^2}{2} = \frac{\delta S V^3}{2g}$ = 6,450 kilogram-meters for $\delta = 1.25$ (15.760 deg.)

[2] The kinetic energy of the air being in effect $\frac{\delta S V^3}{2g}$, the ratio of the two installations is $\frac{1^2 \times 40^3}{1.5^2 \times 18^3}$ = 4.87.

ments. It has been known for a long time that when the angle of attack of an aeroplane is diminished, the center of pressure of the wing travels forward in proportion as the angle grows less. There is, however, a certain critical angle at which the center of pressure reverses its direction of movement and begins to travel toward the rear edge of the plane. This critical angle is known as the "angle of retrogradation." In Eiffel's latest experiments, it has been proved that with a curved surface this angle varies in accordance with the aspect ratio. For any given surface it was found that with an aspect ratio of six, for example, the angle of retrogradation would be 15 degrees, but this would change to 30 degrees when the aspect ratio was only one, and it would be found to be 60 degrees with an aspect ratio of 1/6. The general conclusion drawn from the results of the Eiffel experiments is that for inclinations of the chord of the planes up to an angle of 16 degrees—or, in other words, for such angles as are used in the ordinary practice of aviation—the center of pressure travels toward the rear edge of the plane as the angle of attack diminishes.

The longitudinal instability of many aeroplanes has been attributed to this backward movement of the center of pressure. M. Eiffel has found, however, that by giving the rear portion of the plane a reverse or upward curve, the movement of the center of pressure is reversed. In other words, when the angle of attack is diminished, the center of pressure travels forward, and only travels backward when the angle of attack is increased. This is a result of great practical importance as it means that by having planes with a reverse curvature, a considerable degree of inherent longitudinal stability is obtained. For example, if a machine in flight suddenly tends to dive, the diminishing of the angle of attack will cause the center of pressure to move forward, and this will give a stabilizing effect tending to lift the forward part of the plane. On the other hand, if the angle of attack is suddenly increased, the backward movement of the center of pressure will tend to right the machine and not allow it to assume too great an angle. The only difficulty with the reverse curve is that such a surface does not have as great a "lift coefficient" as does one with a single curvature.

Experiments were made with a single curvature wing, the inclination of the chord of which varied regularly and continuously from the inner end of the wing to the outer end, and it was found that the position of the center of pressure is practically constant within the limit used in actual flying. The reason for this is that the center of pressure of the whole wing is the resultant of the center of pressure of the different portions of said wing. Experiments have shown, however, that wings with such varying angles and inclination of the chords at various points are not efficient. The reason for this probably is that the different portions of such wings cannot be made to work simultaneously at the best inclination.

A number of interesting experiments were made with curved surfaces placed in tandem and connected together. It was found that with such an arrangement of curved surfaces the displacement of the resultant center of pressure could be obtained in an opposite direction to that obtained with a single surface. In Eiffel's experiments three different arrangements of wings were tried. In each case, the wings had a circular curvature with a camber of 1/13.5 of the chord, and a spread of 90 cm. (35.4 in.), the depth or width of the wing being 15 cm. (5.90 in.). In the first position the two wings were parallel to each other and the chords were in the same plane. In this case the displacement of the resultant center of pressure was found to be the same as with a single curved surface, viz., to the rear as the angle of attack diminished. In the second arrangement of the surfaces, the chord of the following surface made a negative angle of 2½ degrees with the chord of the front surface, while in the third position the chord of the rear surface made a negative angle of 5 degrees with the chord of the front one. In each case the distance between the rear edge of the front surface and the front edge of the rear one was twice the depth or width of either equipment. It was found with the second and third arrangement of the surfaces that instead of moving backward, as in the first case, the center of pressure moved forward as the angle of attack diminished. This is a very desirable result as it helps to increase the longitudinal stability. The result obtained with the second arrangement proved this to be the best, as the lift obtained was equal to that of a monoplane of the same area, and for certain inclinations, the lift was even greater.

Experiments were made with staggered biplanes. In one the result of placing the lower surface in front of or behind the upper one with the distance apart of the planes constant was investigated. In the second series of experiments the staggering was constant, but the distance apart of the planes was varied. The result shows (1) that it is not advantageous to stagger biplanes for the purpose of increasing the lift; and (2) a wide spacing apart of the planes is advantageous as far as lift is concerned.

A very important point was the examination of the thickness of wing that could be used without affecting the lifting properties and the resistance. Comparative experiments were made with three wings, the outlines of which were arcs of circles and the greatest mean thicknesses of which were 1/13.5 of the chord. The thicknesses of wings experimented with were 10 millimeters, 14 millimeters, and 18 millimeters respectively at their central points, so that, supposing these wings to be 1/10 the size of full sized wings, the thickness of the latter at their central points would be respectively 3.94, 5.51 and 7.09 inches. The dorsal convexity of a wing having a given maximum thickness increases with the thickness, while the concavity of the under surface diminishes.

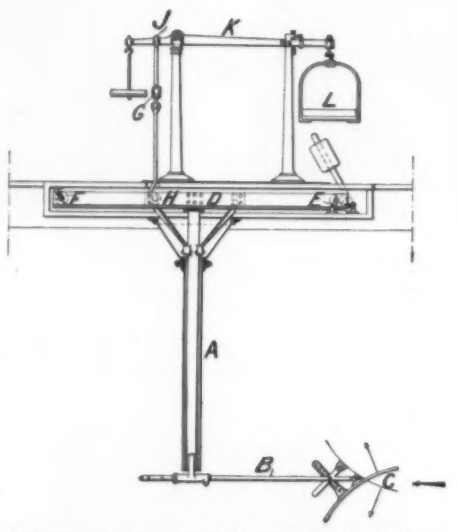
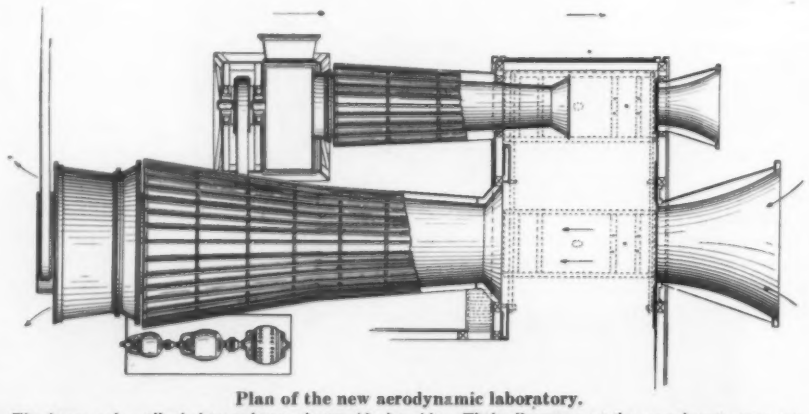


Diagram of aerodynamic balance used in testing aeroplane surfaces.

Principle of Operation.—The vertical post *A* of the apparatus supports, by means of the horizontal rod *B* with its fittings, the surface *C* to be tested. *A* is attached to a horizontal arm *D* that can be made to oscillate successively upon the points *E* and *F* according to the position of the eccentric *G*. The pressure upon the arm *D* is transmitted through the connection *H J* to the beam *K* that carries the plate *L* upon which is placed the weight that establishes the equilibrium. A third test made with the plane turned 180° around the axis of the rod, gives the determination in amount, direction, and point of application of the resultant force indicated in the drawing.



Plan of the new aerodynamic laboratory.

The large and small wind tunnels are shown side by side. Their diameters at the experiment room are 2 and 1 meter, respectively.

It was found that the thinnest wing was the one which had the smallest drift for a given lift, and that it also produced the greatest lift. The distribution of pressure on the under as well as the top surface of the wing was practically the same in the three cases, and this was also the case as regards the variation of the center of pressure.

Eiffel's work makes it possible to calculate a full-sized aeroplane from the data obtained in experiments with a model. A certain "coefficient of enlargement" is employed. In nearly all cases the full-sized machines thus determined have given the results expected. A notable instance of a machine calculated from experiments with a model was the aerial taxicab built by Blériot for M. Deutsche de la Meurthe, and M. Eiffel believes that he will soon be able to give a still more exact "coefficient of enlargement."

Source and Use of Commercial Balata

BALATA is the trade name of the coagulated milky juice of the bully or bullet tree (*Mimusops balata*, Crueg.) of the West Indies, Central America and northern part of South America. The tree is found most abundantly in Trinidad, Guiana, Venezuela, and in the northern part of Brazil. It is said to flourish in parts of Central America, but the species here is unimportant as a source of balata. The milky fluid procured from this tree has been used as food by the natives of Venezuela and Guianas since time immemorial, and it was used also by the early colonists.

The milky juice is said to be quite palatable and is almost similar to the milk produced by the famous cow tree (*Brosimum galactodendron*, D. Don.) of Peru which is also called *palo de vaca* or *arbol de leche*, and belongs to the same family (*Sapotaceæ*) of plants as the bully tree. It has the consistency of cream and may be used for the same purposes to which animal milk is put. It was not until 1860 when the sweet white sap or gum of this tree was introduced as a substitute for India rubber in European industry. Its use increased so rapidly that five years later Berbice, British Guiana, exported 20,000 pounds to Europe. The first balata for export was obtained from trees grown in the low swampy area along the Canje Creek, near New Amsterdam in British Guiana, and a large supply is still derived from that region.

There are two methods used in extracting the sap, and both are crude and exceedingly wasteful. By the one method the operator removes first the coarse outer bark of the tree and then "taps" it by making a number of incisions usually in an oblique direction and extending as high up the trunk as the man's arm will reach, usually about seven feet. At the base of the tree and just below the lowest incision a ring of clay is wrapped around the tree which serves to catch the escaping sap, which is collected in calabashes (fruit of *Crescentia cujete*, L.) or other non-metallic vessels. The quantity of sap obtained varies from 6 to 30 ounces, which when dried amounts to about one pound of solid balata.

The other method of gathering the sap is very wasteful and destructive, because the trees are cut down and the logs of these forest giants are left to rot on the ground. Immediately after the tree is felled the operator makes circular cuts one inch broad and about one foot apart throughout the whole length of the trunk and larger branches, placing a receptacle beneath each cut. An average tree yields generally from six to twelve pounds of dry balata; very large, thrifty specimens often produce as high as 45 pounds. This method is said to produce the best gum, but the great loss involved in allowing the tree to rot is so short sighted a policy that it reminds one of the early destruction of the magnificent hemlock trees in this country, which were cut down solely for the tannin in the bark.

Owing to this destructive system of collecting balata the available supply in Dutch Guiana is gradually diminishing from year to year. During the period of (1910) for which there are full official returns, it is found that the declared value of balata exported from Dutch Guiana to the United States was $21,000, of British Guiana, $86,000, and of Venezuela, $185,000.

The sources of supply are still vast, but the chief difficulty is that trees conveniently located near the banks of rivers were naturally the first to be cut down. Rivers have been worked for a considerable distance from their banks, and in order to reach the so-called unexplored balata forests, still farther inland, it will require much more time and necessitate more labor in getting the balata to the places where it may be loaded on the boats.

The reports of the United States Census Bureau show that the importations of balata from 1906 to 1910 inclusive were as follows:

Year.	Quantity.	Value.
1906	374,220 pounds	$152,689
1907	799,201 "	305,041
1908	584,552 "	276,756
1909	1,157,018 "	522,872
1910	399,003 "	196,878

Sheet balata is now almost never made for export, but block balata is the principal form because this is much more quickly prepared.

Balata vulcanizes readily, and was originally introduced exclusively as a manufacturing article for insulating telegraph wires, but it has since become more familiar in the United States for making chewing gum, and the consumption in this way amounts to practically the whole of the imports.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Government, the Unions, and Safety at Sea.

To the Editor of the SCIENTIFIC AMERICAN:

Now that the United States Senate committee investigation into the loss of life in the "Titanic" accident has aroused the British and American governments, will the officials of both governments stop about half way in one of the most vital points of safeguarding life at sea on passenger ships, and go to sleep like the British Board of Trade, or will they sweep all obstacles out of the way that would interfere with the very best efficiency that could be maintained?

The traveling public at sea must always be dependent on the efficiency and training of the ship's crew, just as the general public looks to the crews of the life-saving stations of the United States and Great Britain for saving the lives of people on ships meeting with serious accidents on the coasts.

The writer has a crew of sailors that is a credit to the profession. Just recently they put up a heroic fight, in the face of a hurricane of wind and mountainous seas, to effect a rescue. After seeing three boats stove, in the work of rescue, they pleaded with me to let them try again, each one of them begging me to let him go in the boat.

Just recently, in a certain port, a delegate of the Seamen's Union came on board and told these sailors that, unless they joined the union, he would have them taken out of the ship. The men did not belong to any union, and did not wish to join any union.

The union was in a position to make its threat good. For, since the firemen on the ship and many other different members of the crew belonged to the union, they could be called out when the ship was ready for sea; and in order to get the ship to sea on schedule time, I would have been compelled to let this crew of first-class seamen, that I knew could be relied on in any emergency, go, and take a crew of union men, all strangers to the ship and the equipment of the ship, and strangers to myself and officers, men whose efficiency we knew nothing about, and men who might prove perfectly useless in case of emergency.

If it is necessary to have the union look after the interests of seamen, then, in the case of passenger ships, let the union present the case to the government officials, and let the government officials investigate, in a practical business way, and decide the issue.

At this same time, the steward came to me and said that he was afraid he would have to leave the ship, as he did not want to join the union. A union delegate had been to him and said that unless the steward joined the union, he, the delegate, would call out all the union men on the ship; that they would not allow any union men to sail under him, and in this event, the company would have to discharge him or have the ship detained. I may mention that this steward has been on the ship a long time, and is well acquainted with all the life-saving equipment and its operation. A man like this is just as valuable to assist in safeguarding the lives of passengers at sea in case of a disaster as any other officer connected with the ship. Would another man, strange to the ship, be as valuable?

In the case of bridge, house, or other construction, or in any of the various trades, should the unions force out men and replace them with men that are incapable, the union delegate is always at hand, and no doubt, can get men that would be satisfactory. But what can you do in case of a disaster on a passenger ship, hundreds of miles at sea, if you should find part of your crew does not qualify in the all-important work of saving lives? Can you, in this position, call for the union to send suitable men? Yet, under existing conditions, you may have been forced, through union interference, and just before sailing, to discharge excellent, capable men. It is getting to be next to impossible to keep together a first-class, well-trained crew on a passenger ship. There are many first-class men that do not belong to any union. You may have such men among your crew. The union delegate comes on board, and finds out that here and there among the crew there are men not belonging to the union. At once pressure is brought to bear. If the men will not join the union, the policy of the union is to call out the rest of the crew, and if the steamship company does not wish to have the ship detained they are forced to let first-class men go and take others that they do not know anything about.

It must be apparent to any reasonable mind that the crew of a passenger steamship must, in case of an accident, stand between the passengers and death. For this reason there must be no interference. Capability is what is required, regardless of union or non-union men. Let the government supervise this matter, and hold the steamship companies and their officers to a strict accountability. Let a heavy term of imprisonment await any person or persons who attempt to force out or force in any crew, any man or men of a ship's company, or interfere in any way with the selection of a crew on the ground of efficiency.

A COMMANDER OF ONE OF THE PASSENGER STEAMSHIPS.

Rust-proof Coatings

To the Editor of the SCIENTIFIC AMERICAN:

We have many discussions appearing in your valuable paper, SCIENTIFIC AMERICAN, on metal corrosion in gaseous atmosphere, etc. The test reported by you in a December issue, where after placing for 289 days in a tunnel of special coated metal, soft steel uncoated, special galvanized iron, special iron uncoated, the loss per square inch surface was in grains 0.51, 0.55, 0.67, 1.72, respectively, showing the great benefit of special coating. As your readers interested know, it all depends on the purity of the metal used, etc. Now in coating iron and steel with terne, a mixture of tin and lead, observers of terne sheet roofings have noticed that in time the finer metal tin disappears, leaving the lead coating. Again, there is a difference between lead and lead coatings, but I advocate a pure lead coating of iron and steel, which I worked at in England and Germany. Any information required on this process by manufacturers, I am willing to give to readers of the SCIENTIFIC AMERICAN.

New Castle, Pa. DANIEL R. JENKINS.

Denmark and the Diesel Engine Ship

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of March 23rd is an article about the oil-engined "Selandia." Great praise has been bestowed on this ship in England by the foremost constructors in the United Kingdom, by the Minister of Marine, and by all interested in naval affairs. Having derived much benefit from your discussion of the oil engine as a future means of propulsion, I take the liberty of calling your attention to a point that you have apparently overlooked.

The Diesel engine was not adapted to big ships before a practical reversible gear was invented, and for this and all other details patents have been granted in all countries to *Danish* engineers who have designed and built this ship. The sister ship "Jutlandia" is being built in Scotland—after Danish plans—only because the builders in Copenhagen are crowded with orders for ships of this class.

Detroit, Mich. AXEL STOCKELBACH.

Control of Amateur Wireless Telegraphy

To the Editor of the SCIENTIFIC AMERICAN:

The question of wireless interference, which has recently been brought up again by several bills before Congress, seems to have started almost as soon as wireless telegraphy was thought of; and as the question is not yet settled, you may be interested in a few words from the standpoint of an amateur.

I believe, contrary to the opinion of some, that the amateurs as a whole are naturally co-operative, and in support of this belief I would point to the large list of "wireless clubs" all over the country. I believe the amateurs would gladly band together in some organization if the government would recognize, and, in a certain measure, father it, perhaps appointing a man to help in its organization, to help the amateurs work collectively in improving the art, and to suggest methods for eliminating the present seeming conflict between amateurs and other stations. The cost to the government would be small compared with the good that might be done. Such an organization could probably be made semi-official.

It is evident, however, even to the greenest amateur, that something, both legal and scientific, will have to be done soon to relieve the situation. When lives are at stake, there should be no danger that less important messages will drown out the signals of distress. This conflict of messages is, however, more marked among the commercial and naval stations than between these and the amateurs, who usually have very moderate power and who should not be near large commercial stations. I admit that some amateurs are malicious or foolish enough even to send fake distress signals, and to guard against this their wave lengths, unless they are licensed, should be so regulated that the operator who receives such a message will know whence it comes. Many large stations are located in large cities, and in such situations should not expect to do good work. The amateurs in a large city should not be stopped in order that a badly situated government or commercial station may operate, although their sending power might be somewhat limited.

The ether should be used to its full capacity so long as the different stations using it do not seriously conflict with one another, but to keep the different classes working harmoniously is certainly no job for members of Congress. The questions to be considered are technical, and must be studied for answers. Laws cannot discriminate between the innocent and the guilty, and if any hard and fast law were passed, much injustice would certainly be done. The remedy seems undoubtedly to be a scientific wireless commission, composed of experts representing all classes, even, I hope, including the amateurs, who must have in this country between ten and twenty million dollars invested in wireless apparatus.

Such a commission could make needed changes gradually, with little confusion; it could keep pace with scientific progress as no law ever could; it could keep stations from being erected where they would interfere with existing stations. Different classes could be allotted different wave lengths after making a study of existing conditions. The commission could limit amateurs and experimenters to certain wave lengths, say under 300 meters, unless they have licenses, issued to responsible persons and to be revoked if privileges are abused. Under the same conditions they could limit power in sending to one kilowatt or even less near important stations. The commission should be given added powers in times of war and in emergencies such as the recent "Titanic" affair. In every way such a commission seems far preferable to any other scheme that I have heard of; and unless they are doing real harm, amateurs and experimenters should certainly have nothing to fear from a fair-minded commission of this sort. H. C. H.

Waterville, Mass.

Should the Atmosphere Be Conserved?

To the Editor of the SCIENTIFIC AMERICAN:

This is a serious question. Scientific men have seen the vital need of conserving the forests. They tell us that the melting snows of winter saturate the forests, which, like sponges, hold the moisture, relinquishing it little by little through the summer, thus maintaining a fairly uniform humidity for the year. We are further informed that excessive timber-cutting on the watersheds engenders floods in spring and drouth in summer. But the conservationists, when first calling our attention to the necessity for preserving our standing timber, failed to make the most of one of their strongest arguments.

We are dependent upon vegetation for the removal from the atmosphere of that product of combustion, carbon dioxide, which we know to be inimical to animal life. Were man not undergoing a vast industrial expansion, the amount of carbon dioxide which his mere living exhales would amount to practically nothing. But he is tearing from the earth great strata of coal and feverishly uniting it with the atmospheric oxygen and pouring it back into the atmosphere from which nature once so carefully eliminated it.

Conflagrations among the forests and the abodes of men swell the increasing amount of carbon dioxide with which the atmosphere is annually burdened. Many industries, as, for example, the manufacture of lime from limestone by the addition of heat, are adding carbon dioxide to the air in ever increasing volume. Our present yearly growth of vegetation is abstracting this carbon from the atmosphere for its needs; can it completely balance the equation which man's industrial activity has created? This is a serious question indeed.

It will take much research before the writer can answer it. But the need of assistance in the search through the by-paths of statistics leads him to interest other minds in a subject which is obviously of vital importance. Aviators have noted inexplainable absence of available oxygen in the upper strata of the atmosphere. If there is danger ahead for the human race from this source, knowledge of it can come none too quickly. The bacilli beneath our microscopes, whose effluvium ultimately so poisons the environment as to destroy the colony, warn us that man himself is not above the possibilities of a like reaction.

The delicate adjustment between this function of vegetation and the carbon dioxide in the atmosphere is not the immediate subject of our query. Man is using up the atmospheric oxygen (aside from uniting it with carbon under his boilers and elsewhere) by combining it with solids where it must lie, unavailable, for ages. This oxygen is as much "consumed" as the coal, the iron, copper, etc., whose visible supply is said to be sufficient for but a few centuries longer.

Think of the amount of atmospheric oxygen that is yearly converted to a solid form by the natural oxidation or rusting of iron, the world over. Then consider the gigantic metallurgical plants whose blast furnaces consume uncalculated millions of tons of oxygen each year which is discarded in the slag. The reduction of metals and the manufacture of steel lead in spending that most important of all natural resources, the atmospheric oxygen. Is then this still more delicate balance maintained?

If we are agreed that a time, not far distant, will find man without coal or iron, because the atmospheric oxygen is invisible are we to leave it out of our consideration until it is perhaps too late?

THORINGTON CHASE.

The Automobile as a Portable Source of Power

Auxiliary Uses for the Motor Vehicle Engine

THE automobile has undoubtedly been a great boon to persons living in suburban and farming communities, when considered merely as a means of transportation. However, in such places there is always a great demand for light, portable motors. The engines generally placed in the up-to-date car are sufficiently powerful to meet any of these demands if some way could be devised to render such power readily available. A practicable device of this kind more than doubles the utility of the car without entailing any great additional wear, except on the engine and certain parts of the transmission apparatus. Many ingenious devices have been utilized for harnessing up the automobile to drive fodder cutters, corn shellers, pumps, etc., and occasionally patents have been granted on such apparatus, but the art is necessarily in its infancy. As the demand for appliances of this kind will undoubtedly grow, it may be expected that increased attention will be given to this subject by future inventors.

Most of the devices now patented are quite simple and do not involve any structural changes in the car itself and are divisible into two general classes, the first in which the rear wheels are made to rest on friction rollers which are put in motion when the wheels of the automobile are revolved by the engine, and second in which the rear end of the automobile is raised free of the ground. In this case, the rear wheels become, as it were, flywheels from which driving belts may be run to the machine to be operated.

Examples of the first class are shown in Figs. 1, 2 and 5. In Fig. 1 the rear axle of the automobile rests in Babbitt metal bearings on supports which hold the driving wheels off the floor. In the rear is mounted a shaft carrying two grooved friction pulleys in tight contact with the tires of the driving wheels. By means of the squared ends of this shaft and a belt pulley mounted thereon, power may be transmitted from the motor to the machine to be operated, such as a threshing machine, wood saw, etc. In Fig. 2 the friction rollers are mounted on two shafts located in a hole in the floor. The inventor of this apparatus contemplated gearing up these shafts with an electric motor or with a pump for pumping water in case of fire. When it is desired to run the car off the transmission device, a brake is applied to one of the shafts and the car can then be run forward upon the floor. In Fig. 5 the automobile rests on four supports pivoted to the floor and which thrust the car back against the grooved friction wheels of the transmission shaft mounted in the rear. Trap doors are located under the rear wheels of the car. These doors are normally out of contact with the wheels, but when the car is to be removed, the trap doors are lifted by the overhead lever and then the car can be moved forward off the supports readily and expeditiously.

A good example of the second class is illustrated in Fig. 4, where the rear end of the automobile is rigidly held on a supporting frame sufficiently high to keep the drive wheels out of contact with the ground. A pulley shaft is journaled in the other end of the frame and is driven by belts from the driving wheels of the motor vehicle.

Fig. 3 illustrates an ingenious device consisting of two friction rollers mounted in a stout frame. An axle of one of these rollers is suitably connected with an air pump and also by means of a flexible shaft with a grinding or other tool of similar nature. When needed, the frame is placed on the ground and the automobile is moved until one of the driving wheels rests on the rollers. When the engine is started, the rollers will be revolved by the driving wheel and the tires on the other wheels may be inflated or a tool may be operated if desired.

Other inventors in this field were apparently inspired by sad experiences of having been stuck in the mud with no mules in sight, for a number of patents have been granted on mechanism for hauling the automobile out with its own power. This means consists of a windlass of some sort on the automobile and adapted to be geared up with the transmission. To this windlass is attached a rope, the other end of which is connected to some fixed support such as a tree, stake, etc. Fig. 6 shows a device of this type in which the winding drum is mounted underneath the body, and by means of bevel gears and clutch can be connected up with the engine. A more simple apparatus for accomplishing this result is illustrated in Fig. 7. In this case, the inventor proposes to use winding drums which can be bolted to the driving wheels of the automobile whenever desired. These drums are simply metal disks having grooves on their periphery for the hauling ropes and radial grooves on their inner faces to fit over the spokes of the driving wheel. When not in use, the drums may be detached and stowed away in the automobile body.

In automobile trucks designed to transport brick and granular material, such as coal, sand, gravel, etc., a dumping body appears to be an essential requisite. Owing to the great weights carried by these trucks, dumping by hand is very difficult and inventors have been busy devising means whereby the dumping may be done by power from the motor. The apparatus shown in Figs. 8 and 9 is the product of French inventors. In Fig. 8 a screw threaded shaft is mounted longitudinally in the chassis of the truck and this shaft is so geared to the motor that it may be turned in either direction. On this shaft is a nut which travels back and forth on the shaft and two links pivotally connected to the nut and to the sliding body, causing the body to slide backward or forward according to the direction in which the shaft is turned. When the load is to be dumped, this shaft is rotated to the right, which causes the nut to travel backward, carrying with it the sliding body. Near the limit of its rearward movement, two rollers on the sides of the body strike inclines fixed on the chassis, and this causes the front end of the body to tilt upward. Further upward movement is effected by the upward thrust of the links due to the backward movement of the nut. When the body has been tilted to the proper angle for unloading, the screw shaft is automatically thrown out of gear. After dumping, another gear is thrown in by hand and the screw shaft is rotated to the left, causing the nut to travel forward, pulling the tilted body back into its normal position. When the body is near the limit of its forward movement, the shaft operating mechanism is again automatically thrown out of gear. The dumping mechanism shown in Fig. 9 belongs to the same type as that of Fig. 8, but is less elaborate, and the tilting body is drawn back into normal position by means of a rope attached to the front end of the body and to a winding drum back of the driver's seat. The truck shown in Fig. 10 was invented by an American. To the front end of the body are secured crescent-shaped racks and these racks slide in clevis-shaped straps secured to the truck frame. A shaft carrying pinions which mesh with these racks is mounted transversely of the truck frame. This shaft can be geared with the motor, so that when power is applied, the front end of the body is raised and the load is dumped.

Fig. 11 shows a type of truck specially adapted for handling fine material, such as grain or street sweepings. The bottom of the body has a hopper shape and in this part two screw conveyors are mounted which, by means of a chain gear and a sliding clutch, may be connected up with the motor. These conveyors discharge the contents of the body upon the endless apron of the inclined elevator secured at the back of the truck. This elevator is run by the motor, the power being transmitted through a longitudinal shaft located in a housing between the conveyors. A spiral gear is mounted on the rear end of this shaft and this gear meshes with a similar gear on the elevator only when it is in its inclined or operative position.

It is quite common to provide traction engines to be used for well digging and the like with power-operated winding drums, but it is only recently that patents have been taken out for motor trucks equipped with such an attachment. Fig. 13 shows such a drum mounted under the driver's seat and adapted to be geared up with the motor whenever desired. This drum can be used for drawing heavy articles on the truck, as well as for hoisting purposes. Fig. 12 discloses a motor truck equipped with a crane or derrick and a capstan. This truck is, of course, so constructed that power may be transmitted either to the truck driving wheels or the capstan, just as desired. This truck so equipped is specially suitable for handling heavy commodities such as stone and timber, but, while the crane is intended primarily for loading and unloading the truck, it could be used for other purposes. Also, the capstans could be used for drawing the trucks out of the mud in the manner described above.

Wireless Weather Reports from the Atlantic

IT is now eight years since the first attempts were made to extend the charts or the basis on which daily weather predictions are made, by including thereon reports by wireless telegraphy from ships at sea. The idea, when first put forth, was received with enthusiasm by meteorologists; especially in western Europe, as that part of the world gets its weather mainly from the Atlantic Ocean, and urgently needs timely information from that quarter in connection with forecasting.

In the execution of this project many unforeseen obstacles arose. The most serious was the very limited range of the wireless apparatus used on shipboard, and the disappointing results of the attempts to relay messages promptly from ship to ship. In general, the messages were received so late at the forecasting centers that they were of little or no practical use. It was also found that the readings of the ships' barometers —the most important information for forecasting purposes—were frequently unreliable. An international commission which met in London in the summer of 1909 to consider this question decided that "the transmission of reports by radiotelegraphy for meteorological purposes from ships must still be regarded as being in the experimental stage," but recommended that the experiments be continued.

In this country the earliest efforts of the Weather Bureau to utilize wireless reports from vessels date from 1906. The service was discontinued in 1907, as it was found that messages were only received promptly from vessels close to shore, where the existence of neighboring land stations made them superfluous. Soon afterward the service was revived, but only on the Pacific, where it has been kept up in a desultory way ever since. The paucity of vessels carrying wireless apparatus on that ocean, and their entire absence from the greater part of it, explain the fact that the results attained have hitherto been of little practical value. However, this service is growing. During 1911 the Weather Bureau station at San Francisco received 244 reports by radiotelegraphy, while 244 were received at Portland, Oregon. Some of these were relayed by cable from Alaska.

During the autumn of 1910 the Weather Bureau concentrated its efforts, so far as wireless telegraphy was concerned, upon the problem of getting prompt information of West Indian hurricanes by this means. The undertaking met with gratifying success. Many valuable reports were received from vessels in the neighborhood of tropical storms; and one of these, from the steamship "Abangarez," gave the forecasters their first intimation of the existence of the most notable hurricane of the season. Moreover, this report, in connection with those from land stations, made it possible to locate the center of the storm with great accuracy.

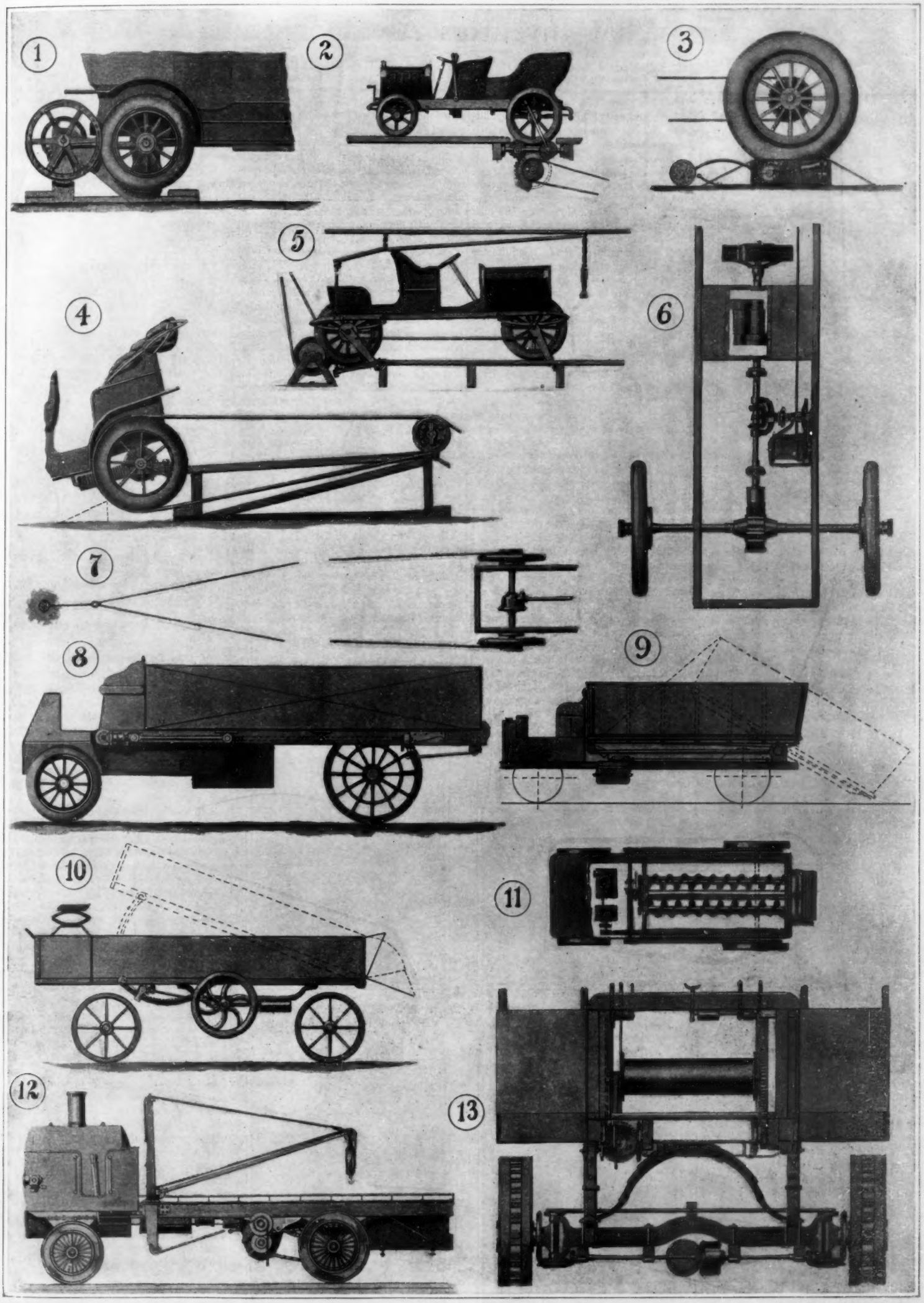
Encouraged by this experience, the Weather Bureau has now embarked upon a more extensive undertaking of the same character. Since the first of April reports of observations made twice a day, viz., at 7 A. M. and 7 P. M., have been radiographed from twenty steamers plying between the United States and ports on the Caribbean and the Gulf of Mexico. The service has been prompt and efficient, and the forecasters at Washington believe that it will be well worth retaining permanently.

The importance of keeping close watch of the meteorological conditions over the Spanish Main will, of course, be greatly increased in the near future in view of the shifting of trade routes that will follow the opening of the Panama canal.

The Gould-Scientific American Prize

THE final date for receiving entries for the $15,000 prize which Mr. Edwin Gould promised through the columns of the SCIENTIFIC AMERICAN to award "for the most perfect and practicable heavier than air flying machine, designed and demonstrated in this country, and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together," is June 1st, 1912. Last year five designers entered their machines, but of these only one declared himself ready to submit a complete machine for test. We sincerely hope that this year a better showing will be made. If a sufficient number of entries is not forthcoming, the offer of $15,000 will be definitely withdrawn.

Mr. Gould's offer is unique. So far as we are aware, it was the first prize ever given for a mechanical improvement in the flying machine and not a prize for a mere performance in aerial acrobatics, an improvement moreover which is intended to make the flying machine a safe vehicle, and thereby increase its popularity.



1. Jacking up a machine so that the motor may drive a thresher or the like. 2. Friction rollers are mounted on two shafts located in a hole. The shafts are to be geared up with an electric motor or with a fire pump. 3. When the engine is started, the friction rollers in the frame are revolved by the driving wheel, and the tires on the other wheels may be inflated, or a tool may be operated. 4. Using the driving wheel as a pulley to rotate a shaft by means of a belt. 5. The automobile rests on supports, which thrust the car back against grooved friction wheels of a transmission shaft. 6 and 7. Making the automobile haul itself out of the mud. A winding drum and rope is used. 8, 9 and 10. How the automobile can be made to dump its load by its own motive power. 11. Screw conveyers discharge a load on the endless apron of an inclined elevator at the back of the truck. 12. A motor truck equipped with a crane or derrick and a capstan. 13. A drum mounted under the driver's seat can be geared up with the motor whenever desired.

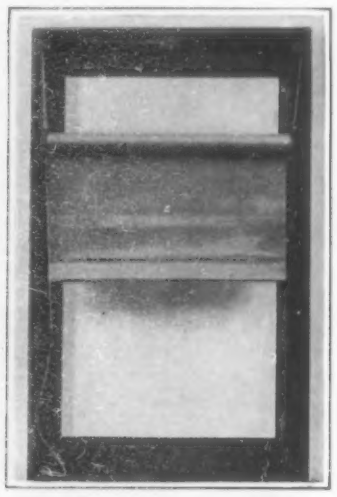
HOW THE MOTOR OF AN AUTOMOBILE CAN BE USED INSTEAD OF MUSCLE

What Inventors Are Doing

Simple Patent Law; Patent Office News; Inventions New and Interesting

An Adjustable Window Shade

OUR attention has recently been called to a simple yet ingenious arrangement for adjusting window shades. As shown in the illustration the shade roller is supported in such manner that it may be raised or



An adjustable window shade.

lowered to any desired position. Hence it may be adjusted to cover all or any portion of the window instantly. The device is particularly useful for admitting light and air at the top of windows. It differs from other shades in the fact that it equalizes the stretch of the cord and maintains the shade roller in a level position. In addition to its value as a shade adjuster it prolongs the life of shades materially. It may be used not only in offices, schools and other public buildings, but also in homes.

A New Safe That Resists the Blowpipe

By Dr. Alfred Gradenwitz

IN their struggle against human property, criminals have known how to avail themselves of the most recent achievements of science and industry. Especially in the breaking open of safes and other receptacles containing valuables, they have resorted to almost every process designed by the inventive mind, such as the use of explosives, thermite, blow-pipes, etc. Industry has therefore steadily sought to improve and reinforce the armor plates intended for the protection of safes and other holders, against the criminal onslaughts of burglars, and the assistance of the very builders of armor-clad cruisers was called in.

Interesting tests have recently been made at Messrs. Friedrich Krupp's Steel Works, Essen, Germany, on a burglar-proof door, embodying the highest level of perfection at present attainable in this connection. Messrs. Krupp had in fact supplied the armor, while the door itself had been constructed by Messrs. August Brebeck & Co. of Bremen.

This door is made up of extra-strong angle-irons, having an absolutely smooth outside surface, so as to offer no point of attack to the tools of burglars. It is free to turn round a column flush with the door.

The outside plate of the door is a 10 millimeter Siemens-Martin steel plate, followed —in the neighborhood of the locks—by a 10 millimeter compound armor plate and a Siemens-Martin steel plate of equal thickness. This is followed throughout the height and width of the door by a 10 millimeter compound armor plate, which is so located behind iron brackets as to do away with any possibility of the plate being torn out. After this, there comes an insulating layer composed of girders and a fire and thermite-proof material.

However, the most efficient protection of the locks and bolts is afforded by a 40 millimeter Krupp armor plate 85x25 centimeters extending throughout the breadth of the door, which is proof against drilling, melting and cutting. Both the Krupp armor plate and the thermite-safe layer are lined with a 10 millimeter Siemens-Martin steel plate. This is followed by the lock compartment containing the locks and bolts, closing toward the front and back, which section is lined with a 5 millimeter Siemens-Martin steel plate.

The door is locked by two high-class springless safety locks according to Messrs. Brebeck's powder-proof arrangement. Each of the five steel bolts, 60 millimeters in thickness, is protected by a special compound armor.

This door is lined with Siemens-Martin steel, reinforced by substantial angle irons which are fixed behind the masonry.

This massive armored door, 285 millimeters in total thickness, had been walled up in masonry of equal diameter. Before starting the experiments described in the following the most favorable process of opening the lock was ascertained by means of the engineering diagrams.

At 11 A. M. melting tests were commenced on the outside Siemens-Martin steel plate, with an oxygen-hydrogen flame which, however, proved inefficient. At 11:06 A. M. the largest Fouche welding burner available (worked with an oxygen-acetylene mixture) was resorted to. Fig. 1, which was taken at 11:20, shows this apparatus at work. The gas bottles contained 5,200 liters of oxygen and 4,000 liters of acetylene.

At 11:49 an opening about 400 millimeters in width and 380 in height had been melted into the first plate (Siemens-Martin steel 15 millimeters thickness), the gas consumption being 1,140 liters of oxygen and 1,000 liters of acetylene. At 12:33 the two following plates (10 millimeters compound armor plate and 10 millimeters Siemens-Martin steel plate, respectively) had been melted through and removed with a hammer, chisel and crowbar, the gas consumption being another 475 liters of oxygen and 600 liters of acetylene.

An opening was now melted and cut into the fourth plate (10 millimeters compound armor) fixed behind angle irons, which operation, involving a consumption of a further 1,000 liters of oxygen and 960 liters of acetylene, was completed at 1:32.

The thermite-safe insulating layer being now disengaged, its iron parts were melted through and removed together with the fireproof material, with the aid of the hammer, chisel and crow-bar. This operation, inclusive of the burning out of the 10 millimeter Siemens-Martin steel plate No. 5, lasted until 4:25 P. M., entailing a consumption of another 2,300 liters of oxygen and 1,400 liters of acetylene. (New bottles containing 4,420 liters of oxygen and 8,360 liters of acetylene had been connected up at 3:15.)

Fig. 2, which was taken at 2:30, illustrates the removal of the thermite-safe layer. Fig. 3 represents the door with the Krupp armor plate disengaged, as it appeared at 4:25.

In order to melt through the Krupp plate 40 millimeters in thickness, a special large-sized welding burner designed for the welding of deep surfaces was used. Starting from the existing keyhole, an attempt was made to melt a larger hole. By 90 minutes' uninterrupted melting the keyhole was at last widened in front to an oval section of about 65x95 millimeters and at the back to about 25 millimeters in diameter, the consumption of gas being about 1,690 liters of oxygen and 2,900 liters of acetylene.

These experiments were discontinued at 5:55, the burner in the deep hole obtained being heated too much by the surrounding steel masses so as to become entirely inefficient, the blow-pipe being thrown back.

These tests lasted about 7 hours, entailing a total consumption of about 6,600 liters of oxygen and 6,900 liters of acetylene, and could only be continued without interruption by the assistance, in their turn, of three experienced welders.

Fig. 4 represents the armored door at the end of the test.

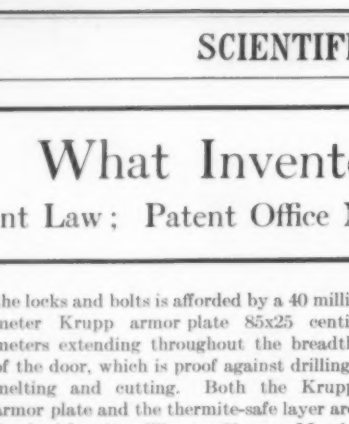
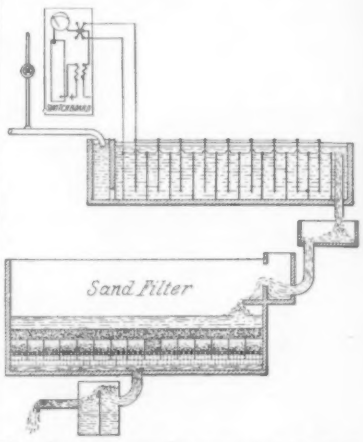


Fig. 1.—Melting test on steel plate, with welding burner worked by oxygen-acetylene mixture.

Fig. 2.—View of melting test illustrating the removal of the thermite-safe layer.

Fig. 3.—View representing the door with Krupp armor plate disengaged after five hours and five minutes work.

Fig. 4.—Represents the armored door at the end of test which employed three experienced welders.



Electric apparatus for removing oil from water of condensation.

Electrical Removal of Oil from Water

By Dr. Robert Grimshaw

THE steam in a steam engine carries with it a not inconsiderable quantity of lubricating oil, which passes off with the exhaust and remains in the water of condensation in the form of an emulsion, that is, in a condition of fine suspension; not in solution. This emulsion has, however, from the point of separation, all the disadvantages of a solution, as the water remains milky and cloudy, instead of letting the oil rise to the surface. Otherwise it would be almost equivalent to distilled water. In any case it is, when freed from grease, especially adapted for boiler feeding, as it contains no mineral matter in solution, and no vegetable or animal materials in mechanical suspension. If the water were used in the boiler again without removing the oil therefrom, the latter would remain behind and cause foaming, or else settle on the plates or tubes and cause burning. If together with the re-fed greasy water ordinary hard water is used, the danger is still more marked, as the oil forms with the lime a deposit which increases the danger of burning plates. If there is so much oil in the water that the oil tends to rise to the surface in bubbles, it must be partly removed by settling for at least half an hour; then the oil which floats on the surface may be either skimmed or blown off. The emulsion must, however, be treated by either one of three different ways, of which only two have been generally employed, namely, chemical action and filtration. The latter is insufficient, because all the grease is not removed, and because the filter becomes less and less effective. It is also a very dirty process, which is not popular with the workmen.

The chemical treatment consists in adding to the emulsion sulfates of alumina and soda; these cause a sediment or precipitate which may be removed by filtration. This process, however, requires very exact proportioning of the chemicals to the constantly varying emulsion. Removal of the oil before condensation is never complete.

The latest process, that by electrolysis, is based on the property of an electric current to form the oil into globules much

larger than the microscopic particles in which it exists in the emulsion. In carrying out this process, according to the Halvor Breda system, there is required a wooden vessel containing a number of metal plates acting as electrodes. The oily water is passed along between these plates; the current is turned on, and the oil is conglomerated as above mentioned. The water is then filtered through gravel. In order to make the oily water a better electric conductor, it is well to mix with it a little ordinary hard water, not enough, however, to lessen its value for boiler-feeding purposes.

The consumption of electricity (continuous current is necessary, but this may be obtained by a converter if there is only an alternating system at hand) varies according to the amount of oil in the water; and is given as about 0.15 to 0.20 kilowatts per cubic meter of water. As a cubic meter is 35.31 cubic feet, this makes 4.3 to 5.7 kilowatts per thousand cubic feet, or, 57 to 76 kilowatts per thousand American standard gallons. The apparatus requires no special attention, being fully automatic. All that is especially necessary is to reverse the current direction every few days, to free the plates from the oily deposit which adheres thereto.

Mattullath Patent Decision

THE reviving of the Mattullath patent application establishes so important a precedent that our readers will doubtless be glad to obtain further information. Certain points in the opinion of the Court of Appeals of the District of Columbia bearing upon the proceedings in the Patent Office, of interest to patent attorneys, have been summarized for the SCIENTIFIC AMERICAN by Messrs. Merwin and Swenarton, counsel for the Mattullath interests.

The brief of the Commissioner of Patents, referring to Section 4894 of the Revised Statutes, states that—

"the decision of the commissioner in this matter has always been held to be final and conclusive, both in the Patent Office and in the courts in suits for the infringement of patents. *This holding is so firmly established and so uniformly acquiesced in that no one heretofore has ever attempted to question it by filing an appeal from the commissioner's decision, holding the delay unavoidable,* either to the Supreme Court of the District of Columbia, sitting in banc, under section 4911 of the Revised Statutes, or to this court since its creation." (Italics ours.)

A number of decisions and treatises on patents were cited in the commissioner's brief in support of the contention that his ruling upon the question of abandonment of an application is final and conclusive. The court in the above decision, however, held that under the Statute, "the striking down of an application on the ground of abandonment amounted to a rejection of the claims."

Regarding the authorities upon which the commissioner relied in his brief, the court says:

"The decisions relied on were made in infringement suits where the commissioner's decision that delay was unavoidable was the subject of collateral attack. On direct appeal from his decision, denying renewal, and therefore, substantially rejecting the application, the situation is very different. While, ordinarily, the exercise of discretion in matters arising in the course of the litigation will not be disturbed unless it has been abused, nevertheless, it is subject to review along with other rulings affecting the rights of the parties and will be disturbed where the error in its exercise is plainly shown, and works material hardship and injustice. Kinsman v. Strohn, 31 App. D. C. 581-585. In that case, it is true, the exercise of discretion in reviewing an application was not disturbed, for the reasons given, but the opinion recognizes the power to do so upon sufficient grounds. Section 4894 of the Revised Statutes does not, in terms, limit this power of review as was the case in some decisions cited. But it is not necessary to discuss this particular question further. In view of the opinion expressed in Selden's case (36 App. D. C. p. 435), it is admitted by counsel for the commissioner, that where the question of abandonment is one of law and not of fact, the action of the commissioner is not conclusive."

The question of whether the attorney of the deceased applicant had the authority to proceed with the prosecution of the application is commented upon as follows:

"The purpose and policy of the patent law are to give the patent to the first inventor unless he has, by his own fault, subordinated his right to a more diligent inventor. The question upon which the right of renewal depended was whether the representatives of Mattullath had 'slept upon their rights.' The delay in reviewing the application would, in reasonable probability, not have occurred but for the *strange action* of the office in acting upon some unexplained source of knowledge of the death of the applicant, and holding that the death absolutely and at once revoked the power of attorney of his solicitors. The amendments proposed by them, presumably without knowledge of their client's death, were formal; they contained no exemplification of the original application and required no additional oath. That the power to make such an amendment had not been revoked by death, and that action could have been taken upon it lawfully, had been declared by the Supreme Court in a decision rendered in January, 1893. De La Vergne Machine Company v. Featherstone, 147 U. S. 209-229. *This decision ought to have been well known in the office.* (Italics ours.)

The Patent Office not only declared the power of attorney of Mattullath's attorney of record revoked by reason of Mattullath's death, but took no steps to notify the deceased applicant's legal representatives of the fact, but claimed that it was the duty of the attorneys of record, notwithstanding the revocation of their power of attorney, to give such notice and that their neglect so to do would be imputed to applicant's administratrix. The court says:

"We do not agree with this. Their negligence in conducting the proceedings, while the relation of client and attorney continued to be recognized in the office, could be imputed to the applicant. But it is unreasonable to argue that their neglect was the neglect of the petitioner, when the office had declared their authority ended. Moreover, they were never the attorneys of the deceased applicant's representatives. Notwithstanding this express revocation, no attempt was made by the office to notify the widow, which it is said by the commissioner it was under no obligation to do even if aware of her name and address. *Rule 20 is the only office rule regarding notice in* case of the revocation of a power of attorney, and this the commissioner held did not require notice to the applicant. The rule, *construed literally, does not seem to require notice to the applicant's representatives, but such construction is within its spirit.* At any rate, the widow and children of the deceased applicant had no notice, and it clearly appears that they had no knowledge of the pending application and were in possession of no facts or circumstances sufficient to put them upon inquiry." (Italics ours.)

The commissioner also contended that the administratrix failed to exercise due diligence by not inquiring of the Patent Office if there were any such application on file, claiming that as a matter of law she should be charged with knowledge that that was the proper course to pursue, and added:

"It is academic that ignorance of the law excuses no one." The court, in passing upon this, says: "Without pausing to consider the many exceptions to the rule that ignorance or mistake of law excuses no one, it is sufficient to say that there is no just foundation for the application of the general rule in this case. There is no statutory, or other rule of law requiring parties to apply for information at the Patent Office. It is a fact that information concerning applications for patents will be furnished to the applicant or his legal representatives or assigns. It is not at all wonderful that a woman like the petitioner should have been ignorant of this fact, especially as it seems not to have been known to the lawyer who advised her where to seek information. Nor is it at all remarkable that she should not have known, in making her inquiries, that there was an essential difference between an application and a patent. It plainly appears from her sworn statements that she did not know this difference, or that she could obtain information of the application by applying at the office. *It was ignorance of a fact, not of law.*" (Italics ours.)

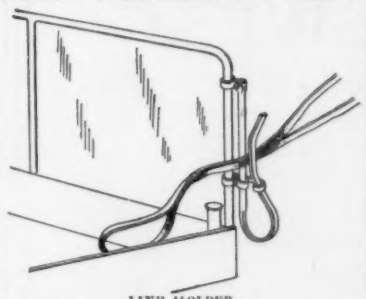
The ruling of the commissioner as to the meaning of the word "unavoidable," as used in the statutes, is criticised by the court, and contrasted with that of Commissioner Hall in *Ex-parte* Pratt, 39 O. G. 1549, 1887, C. D. 31, as follows:

"The commissioner seems to have leaned toward the strictness of the construction first mentioned. We approve, in general, the doctrine expressed by Commissioner Hall. *The first construction is technical, hard and narrow. The second is broad and liberal, breathing the spirit of equity, and more in accord with the general policy of our patent law.* See Smith v. Goodyear Dental Company, 93 U. S. 486-491. Tested by the standard of diligence above declared, we are of the opinion that the delay in this case has been shown to be unavoidable in the proper sense of the statute. The petitioner had not 'slept upon her rights,' and is entitled to the relief which she seeks. Its denial would work a great hardship, unjustified by her conduct, upon the penniless widow of a deceased inventor of merit who died almost at the point of success, leaving the invention as his only property." (Italics ours.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

LINE HOLDER.—G. B. HARLESTON, Stuttgart, Ark. Mr. Harleston's invention has for its object the provision of a simple device for attachment to the dashboard of a vehicle so



LINE HOLDER.

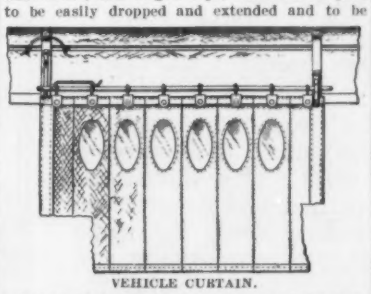
arranged as to permit the lines to be easily engaged and disengaged, which will grasp the lines with sufficient firmness to prevent their accidental dislodgement. The accompanying engraving shows a perspective view of the improvement in place on a vehicle.

ILLUMINATING SYSTEM FOR THEATRICAL DISPLAY.—L. S. HOWARD, Wichita, Kan. By means of this invention a performer, such as a tight-rope walker shown in the engraving, can automatically cause a series of lights to appear and disappear on his apparatus or clothing in manner corresponding to his move-

ILLUMINATING SYSTEM FOR THEATRICAL DISPLAY.

ments. The support, such as a tight-rope, on which a person is adapted to perform, has sections of electrical contact so arranged that the performer will make and break connections between lights placed on his clothing, person, or apparatus.

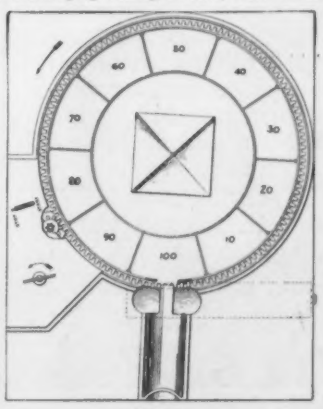
VEHICLE CURTAIN.—C. S. APPLAS, 922 5th Ave., Moline, Ill. This invention is an improvement in curtain attachments for buggy, automobile, and wagon tops, which is adapted to be easily dropped and extended and to be



VEHICLE CURTAIN.

quickly folded and slid laterally out of the way, or raised and secured at the top of the vehicle cover when not required for use. The illustration shows a longitudinal section of a portion of a vehicle top with the curtain attachment extended and suspended as in use.

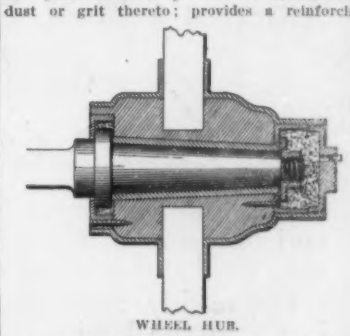
GAME.—G. J. JACCARD, 247 West 38th St., Manhattan, N. Y. This invention comprises a rotating member having a plurality of compartments numbered to correspond with the player's score, together with guiding means for discharging rolling devices, such as balls



GAME.

or marbles, into the compartments of the rotating member when the same is in motion. The player scores for as many balls or marbles as he places in the above-named compartments, and the amount of this score is determined by the number which the compartment in question bears. The top plan of the game is shown in the engraving.

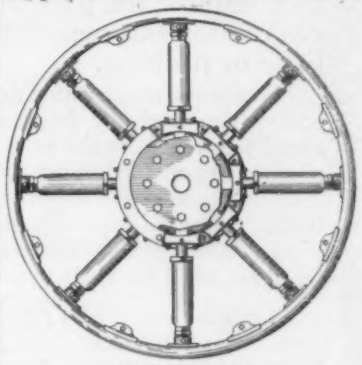
WHEEL HUB.—J. J. MCGUIRE, 48 W. 142nd St., Manhattan, N. Y. This invention provides dust-proof chambers for supplying oil to the axle journal and to prevent the admission of dust or grit thereto; provides a reinforcing



WHEEL HUB.

metal protective shell for the hub and an auxiliary lining for the oil containing receptacle thereof, constructed and arranged to prevent the secpage of oil between the shell and the body of the hub. The engraving shows a vertical longitudinal section of the hub.

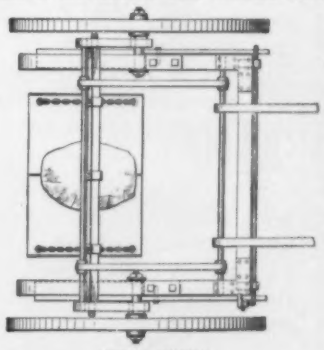
VEHICLE WHEEL.—B. W. MILLER, Bingham Canyon, Utah. In this instance the inventor provides a wheel in which the spokes may be quickly replaced and held rigidly laterally. The spokes are disposed in cylinders



VEHICLE WHEEL.

secured to the rim of the wheel, and the desired resiliency is obtained between the rim and the hub by means of springs. Still another object of the invention is to construct the rim of the two annular members which are clamped together, thereby holding the tire in position. In the accompanying engraving the side elevation of the wheel is pictured.

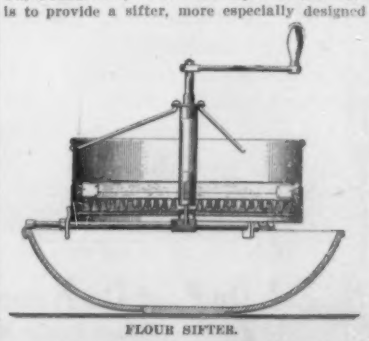
STONE TRUCK.—C. C. MCBRIDE, Bisbee, Arizona. This invention relates generally to stone trucks and more particularly it involves a truck of peculiar construction whereby the stone to be transported may be raised from the ground by movement of some elements carried



STONE TRUCK.

by the truck previous to transportation. The object of the invention is to provide a truck of the class described by which the stones to be raised from the ground and moved to a distance may be so raised and moved by movement of the animal hitched to the truck. A plan view of the truck is shown in the illustration.

FLOUR SIFTER.—J. H. ZYBURN, 109 Main St., Boundbrook, N. J. The object in this case is to provide a sifter, more especially designed



FLOUR SIFTER.

for use in bakeries, and arranged to permit convenient attachment to small or large bowls, and to insure a thorough sifting of the flour. For

(Continued on page 458.)

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6. **Laramie-Poudre Irrigation Project.**
7. **D. L. & W. Cut-off.**

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Military Inventions

By G. H. Powell

FOLLOWING the report of the Endicott Board, which inaugurated the system of modern coast-defenses in this country, there was for two years a failure by Congress to make any appropriations for carrying on such work. This was largely due to the fact that numberless inventors, skilled and unskilled, were clamoring at the doors of Congress for special appropriations to develop this, that or the other style of gun, projectile, fort or submarine mine, and the charge was freely made that the bureaus of the War Department in charge of such work were biased, unfair, and unwilling to take up the many meritorious schemes and inventions presented for consideration.

Out of all this mass of charges and countercharges Congress, in 1888, evolved the idea of a central board to have absolute control, under the Secretary of War, of all expenditures for designing, procuring and testing ordnance and of determining types and constructing fortifications. This body was to be known as the Board of Ordnance and Fortification and was to be composed of army officers representing the various governmental bureaus having charge of such work theretofore. Later a civilian member was added, so that no criticism might justly be made that inventors outside the military services were not represented. This board has been in continued existence ever since, and is now composed of the Chief of Staff of the Army and the chiefs of the great engineering and ordnance bureaus of the War Department in addition to artillery officers representing the ultimate users of the equipment; and while its field of activity has narrowed with the completion of the fortifications and the installation of the modern guns and equipment, it still meets periodically to consider such military inventions as are presented. Important developments in the line of such inventions are naturally rather infrequent, as the material in use represents the concentrated development of twenty years, but every inventor who presents his ideas to the War Department is assured of their careful consideration by this body of experts.

It is rather interesting to know that this board was the first governmental agency to recognize the possibilities and value of the aeroplane, which it did by the allotment of $50,000 to the late Dr. Langley for the development of his machine. This action was taken in spite of the objections and criticisms of scoffers.

The almost perfect range finder of today was developed under the auspices and encouragement of the board, and it is said the inventor and manufacturer, together, of the instruments rushed to our forts in the early days of the Spanish war scare made $75,000 or more from this one type of instrument. As representing the development of the defense auxiliaries, the perfection of the range finder may be taken as a good example. The first specifications required that the maximum error should not exceed one per cent per thousand yards of range. As skill in manufacture increased, the requirements became more rigid until now the average error is less than one per cent of the range at 10,000 yards, and a manufacturer has recently proposed to furnish an instrument with an error of only 20 yards in 10,000. This is much less than the fluctuations in fall of projectiles at such ranges due to atmospheric and other causes.

Another invention which brought rich returns to the originator was the soft cap used on all armor-piercing projectiles, through the medium of which the shot "bites" into the hard face of the armor and holds fast until the energy of the projectile operates to force it through the plate. The inventor realized over $200,000 from this comparatively simple idea.

Earlier experiments conducted by the board determined the form of our coast forts which are, as is well known, merely retaining walls of concrete faced with earthen slopes. A curious fact was developed in the tests. When a projectile was fired at an unsupported mound of sand it would penetrate 30 feet or more and come out on the far side. Now, if this same sand were backed by concrete, the projectile only penetrated 15 or 20 feet and then turned upward and either went high in the air or rested on top of the sand, at times with its point to the gun.

Large sums have been spent in tests of armor plate, rather, however, with the idea of developing projectiles than with a view to use of armor facing for the fortifications, which have an ample factor of safety as at present constructed. But it was desired to know at what angles projectiles striking ships' armor could be expected to penetrate and explode within the vitals of the vessel. This knowledge would save the useless waste of ammunition at impossible ranges and angles of fall. The $60,000 only recently spent in these experiments is considered by the experts money well invested.

Enough has been said to illustrate the general character of the serious work of the board. But there is another side which is at times almost pathetic when one considers the gray matter consumed and the midnight oil burned in evolving some of the wild ideas presented. There was the man who proposed a craft of two large but light open-end cylinders arranged catamaran-like with a frame between for the pilot. The motive power was to be two large sharks. Spark coils ended near their tails. The pilot has merely to press one or the other button to accelerate the speed of the port or starboard motor and he could go in any direction. Bullet-proof jackets have been rather scarce since General Miles, then at the head of the board, offered to make an immediate test by having the inventor stand across the room with the jacket on while the officer fired a round from a 30-caliber rifle at him.

The shell filled with snuff or red pepper and exploded in the enemy's advancing ranks is a proposition many times presented, though often varied by proposing to use chloroform or some noxious gas, either to put the enemy to sleep or kill him outright by asphyxiation. One of the most novel of such ideas was a powerful sun-glass, the rays of which were to be focused on a city and thus start a conflagration that would cause evacuation by the enemy.

The procedure necessary to obtain consideration of an invention is very simple. One merely has to address a letter to the Board of Ordnance and Fortifications stating the nature of the device and submitting drawings and description sufficient to enable the invention to be understood. As all matters are treated as confidential, prior patent is not required. One is thus able to obtain an expert opinion of the probable military value of an invention without cost and with very little expense in the preparation of drawings and description.

The Little Thing That Makes Inventions Big

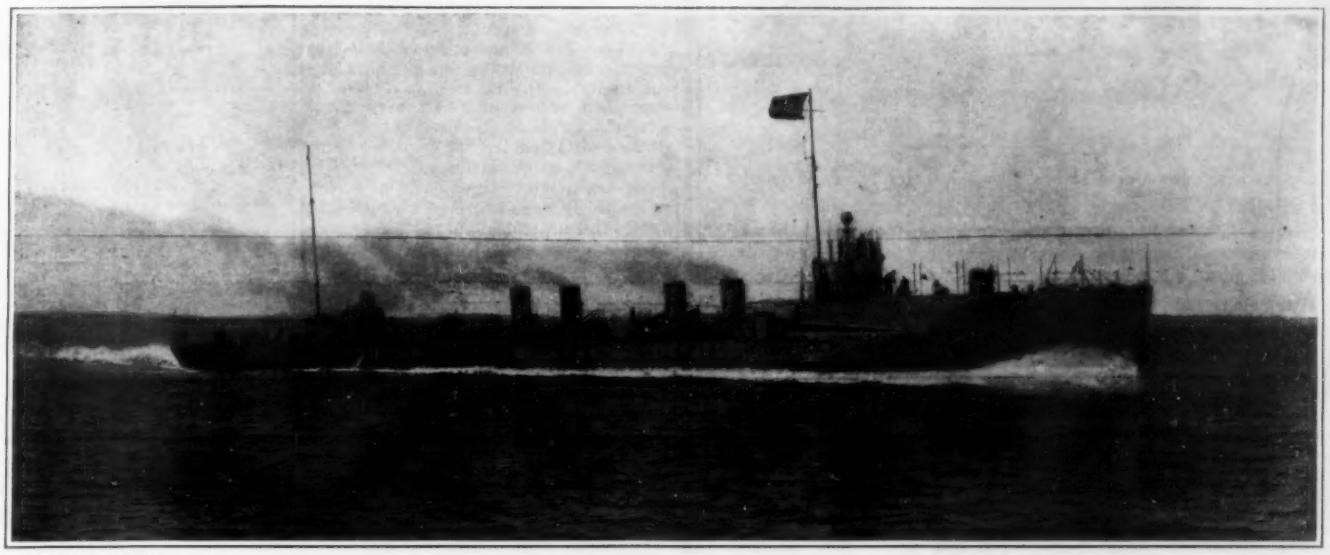
By C. Francis Jenkins

IT is the history of many inventions, especially inventions which bring into popular service some new, revolutionary thing, that though many minds have been working along the same line, for years, perhaps, that almost suddenly one little thing is done which makes the invention practical and every-day workable.

It may be the location of the eye in the sharp end, instead of in the blunt end of the needle, which made the sewing machine practical. Or it may be the backing out of a screw for but half a turn which made the telephone, though other inventors had exactly the same apparatus and lacked only the half turn of the screw. Or, again, it may have been the cross-over problem in the early trolley car in which the current-collector ran along on top the wire, which was solved by the simple expedient of running the collector-wheel on the underside of the trolley wire.

The joke of it all is that many of us try so hard to do the thing in a difficult way, and without success, when it could be quickly done if it were tried in the easy way.

(Continued on page 454.)



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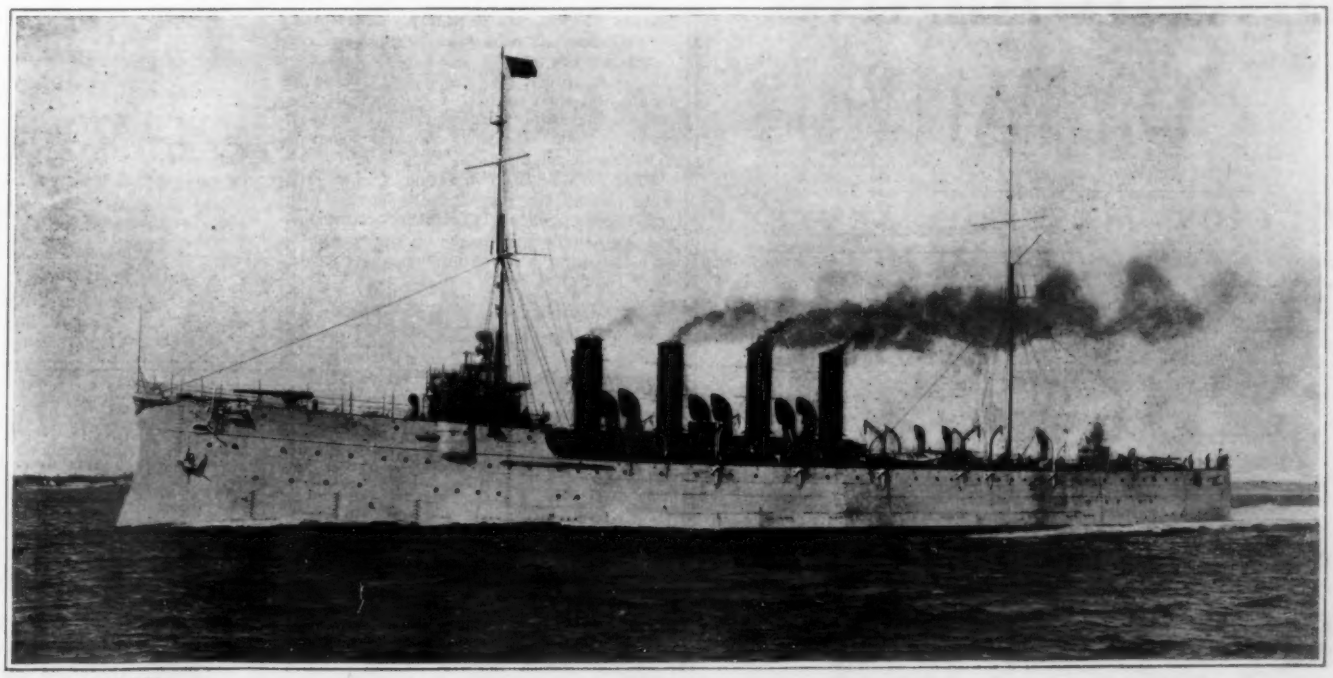

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Length, 420 feet. **Beam,** 47 feet. **Displacement,** 5,750 tons. **Speed,** 26.52 knots. **Maximum coal supply,** 1,250 tons. **Armor:** Deck 1½-inch.
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So, in the problem of projecting motion pictures on a large canvas, it was but a very simple thing which unloosed the flood of motion picture theaters and added a new industry in which many millions are already invested.

Workers in different parts of the world had labored dilligently on the problem, but to no avail. Success, so far as it went, had been confined to very small pictures, exhibited in dark boxes into which one looked through a proper sight opening.

Yet, when the pictures on a large canvas came, it was discovered that all that had been done, which had not before been done by many others in this art, was the simple step of enlarging the light-opening in the rotating shutter of the machine. As simple as the backing-out half a turn of the contacting screw in the telephone, but similarly the one necessary step to a successful operation.

Perforated film had been used for years before motion picture theaters were possible. And identically similar mechanisms to that now employed had been used for the movement of this perforated film through the machine. But each machine failed in illumination when an attempt was made to produce large pictures.

Projecting motion pictures is like painting a monochrome picture on canvas, one must have enough paint. So, when light is the medium employed, there must be enough light to paint a clear, brilliant picture.

Lighting devices of different kinds have been employed in the development of motion pictures, but each with the same limitation. The lighting device used on a machine which was set up by Anchutz in several places in the World's Fair grounds, at Chicago, 1893, was a Geissler tube which was flashed as the pictures came opposite the sight opening. Fine pictures they were, but small.

A little later, the next June, at Atlantic City, an American-made machine was exhibited which used a steady light but interposed a rotating shutter with a light-admitting opening therein, this opening being one-eighth inch wide, in a twelve-inch disk, or a mixture of about one part light to three hundred parts darkness. This also necessarily limited the pictures to a very small size.

When the writer made application for a patent on the present type of machine, a type now used to the exclusion of every other type the world over, the Patent Office called attention to the fact that the device of the application differed from many other patented machines only in that the opening in the shutter was larger, and that, therefore, being but a matter of degree a patent could not be allowed under the rules of practice; which was true enough, but not very satisfactory.

However, the object, though diligently sought, had not therefore been attained by any worker in this art, and, therefore, was entitled to protection. So an appeal direct to the commissioner was taken. An assistant commissioner heard the petition, and then said: "If you can actually do this thing your petition will have consideration. I'll come up to see your exhibition myself."

That evening the two forms of shutter were put on for him, the one having a small opening therein, which produced but dim, shadowy pictures on the screen, and the other shutter having something more than three-fourths of its circumference cut away, and which produced brilliant, fully-lighted pictures.

With the little light permitted to pass the narrow-opening shutter, as with the half pint of paint, but a poor result could be expected, while with the abundance of light permitted to pass through the wide-open shutter, as with an unlimited supply of paint, a beautiful picture could be produced.

However, for not a single moment had there been any doubt of the result, for such demonstrations had been frequently made ever since an evening in October, 1894, in Washington, when a good-sized audience of friends had been entertained with the same crude machine. So the patent was issued, a patent which has stood the test of the courts.

And so, by so simple an expedient as enlarging the opening in the shutter, the "poor man's theater" was brought into being, a theater which seems to be irresistibly crowding into obscurity the cheap vaudeville entertainment.

It is one of the curiosities of invention, this doing for so long a time everything but the one little necessary thing, though

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dozens of workers may be engaged on the problem.

I am confident that when television shall have become an actual fact that its success will lie in just such a simple thing. And television is but motion pictures with the time interval left out.

Yet that elusive little something stands in the way of successful accomplishment for months and months and at a cost of thousands of dollars. And the irony of it all is that most often the party who puts his finger on the thing which releases the flood is some obscure worker who has taken up the matter in the most haphazard manner. Perhaps it's because he is not mentally embarrassed by too much knowledge of the subject and sees it in its true light, while the more experienced worker "knows it won't work."

This should be a cheery thought for the inventor, for by this token he is likely at any moment to do the impossible. Let the inventor say of inventing, as the miner says of prospecting: "There are no rules, gold is where you find it."

Notes for Inventors

Clara Barton as a Patent Office Employee.—It seems that Clara Barton of Red Cross Fame was, many years ago, employed in the U. S. Patent Office. Interest in the subject was aroused by a letter from Miss Clara Barton, dated New England Village, Mass., February 22nd, 1876, in which she said:

"Having been the first woman ever appointed independently to a clerkship in the department over which you preside and trodden alone the thorny paths of the earlier days, I ought to know what should be required to constitute a good and suitable clerk."

In a letter of November 12th, 1903, to Miss Mabel T. Boardman, Secretary Hitchcock goes on to say that in answer to his inquiry on the subject, the Commissioner of Patents reports that no Miss Barton is found upon the rolls of the Patent Office from January 1st, 1853, to date, and that a further search brought to light a letter of September 22nd, 1855, from Oxford, Mass., addressed to the Secretary of the Interior, Robert McClelland by Alexander DeWitt, a member of Congress, in which the Congressman says:

"Having understood the department had decided to remove the ladies employed in the Patent Office, on the 1st of October, I have taken the liberty to address a line to you in behalf of Miss Clara A. Barton, a native of my town and district, who has been employed the past year in the Patent Office, and I trust to the entire satisfaction of the Commissioner."

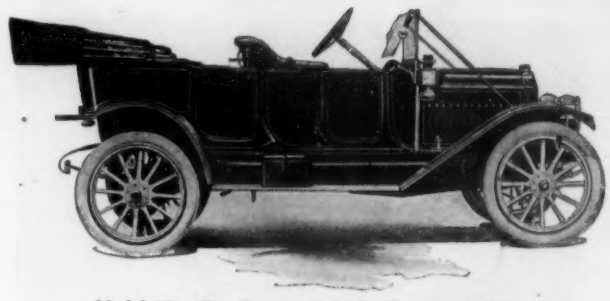
From the foregoing there is no doubt that Miss Clara Barton was one of the earliest women employees in the Interior Department and Patent Office, but as her name does not appear in the appointment records, the precise date or period of her employment cannot be verified. Miss Barton was not, however, the first female employee of the Patent Office as the records show that as early as 1840 and 1841 a number of women were employed in the Patent Office, doubtless in the agricultural branch, as they are designated as seed distributors.

The Would-be and the Actual Inventor.—The following excerpt from the decision of Mr. Justice Robb, of the Court of Appeals of the District of Columbia, in Schmidt v. Clark (138 O. G. 768) may be commended. Discussing priority of conception of an invention and diligence in reducing to practice, he says:

"A would-be inventor frequently has a nebulous and general idea of a result which he wishes to accomplish and possibly a general idea of means to accomplish that result, but, being unable to give his ideas practical form, allows them to slumber. Upon learning that another has successfully worked out such ideas, the mists of uncertainty are immediately dissipated, vagueness takes definite form, and the would-be inventor becomes in his own mind the actual inventor and acts accordingly. The danger and opportunity for fraud or mistake in such cases are so great that the proof should be very clear and very convincing to warrant an award to the dilatory party."

Warming the Steering Wheel.—Grant E. Smith of Poughkeepsie, N. Y., in a patent (No. 1,022,273) provides a hot air receptacle heated by the engine and a pipe which leads to the steering wheel, the latter having a hollow rim provided with an inlet for the heated air and outlet through which the air discharges to the atmosphere.

Elmore



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The Advantages of Owning an Elmore

EVERY one is interested in the silent valveless Elmore. It is a topic of conversation wherever motorists congregate. But in this ad ertisement we want to show you definitely how it is to ***your advantage*** to own one. Here are the three points to consider:

***First*—What the Elmore valveless motor does for you by way of reducing running expense and upkeep cost. *Second*—How its simplicity and freedom from continual overhauling and attention makes it a source of constant pleasure to the owner. *Third*—What it means to have perfect running qualities, backed by simple, even driving power.**

The best way to illustrate these points is to take you with us in an Elmore and explain, as we go along the features that have developed in Elmore owners during a dozen years, a pride of ownership based on the utmost in comfort, convenience, ease and economy.

So let us assume that you are taking your first ride in an Elmore. Start the engine and throw in the clutch. Starting on low gear, you experience an exhilarating feeling which finds expression in an approving grin when you shift from first to second speed for you are now learning for the first time what even running really means.

And Here's Why

In the ordinary poppet-valve motor, either four or six cylinder, only every fourth impulse of the piston is a power impulse. With the valveless Elmore motor, every other motor impulse is a power impulse. One power impulse follows the other so closely as to overlap and renew the energy transmitted to the rear wheels before the previous impulse is exhausted. When the power impulses do not overlap, the operation of the motor is naturally "jumpy." But the continuous power impulses of the Elmore motor insure even revolutions of the shaft that result in a smoothness of operation obtainable in no other way. Think it over.

The hill just ahead of us is long and steep. Don't shift gears or race at it for it is not necessary. Even if you are running on third speed forward, even though the road be cut up, sandy, muddy or covered with snow, you take it smoothly and without strain.

The Reason For It

The ordinary poppet-valve motor should do the same if properly tuned to its maximum efficiency, and if the 80 to 160 parts connected with its valves and their actuating mechanism are working properly. But these delicate parts, constantly subjected to the jar and strain attendant upon the operation of the motor, are seldom in perfect coordination. And a variation of one two-hundredth of a second in their work means trouble. 90% of repair bills are for "grinding and adjusting" valves. 90% of car trouble is due to defective or worn valve parts. In the Elmore valveless motor fuel distribution is accomplished by a rotary gas distributor which is bound to coordinate perfectly with the cylinders. Nothing to get out of order, hence no loss of power.

We are getting back into town and there seems to be a lot of traffic on the streets. Right here is where another Elmore characteristic is apparent. Just see how slowly you can crawl along on "high." Delightful feeling when you are not compelled to shift gears constantly.

"All the Pleasure Without the Annoyances"

That covers every phase of Elmore ownership. By actual test, you will find that for fuel Elmore mileage costs about what the ordinary automobile mile costs. For repairs, truthfully—next to nothing. For lost time—one Elmore owner drove his car over a year without knowing where the spark plugs were. Not much wrong with his motor. Didn't know much about a motor either, but like everybody else, he got a car to ride in—not to tinker with.

Constantly improving a successful motor costs less than exploiting a new motor each year. The Elmore Manufacturing Co. has used the valveless type motors for 12 consecutive years. Elmore prices range from $1050 to $1650—there is a model to suit every motoring need.

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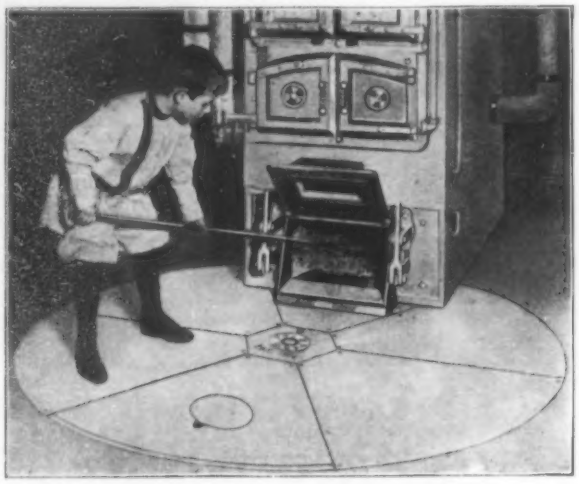

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(Continued from page 451.)

this purpose use is made of a support provided with lugs for engagement with a bowl, a sifter body having a bottom sieve and resting on the support, and a revoluble brush journaled on the sifter body and operating over the sieve. The illustration shows a side elevation of the sifter as applied to a large bowl.

Pertaining to Apparel.

PIN GUARD.—H. W. MATTONI, 217 W. 120th St., Manhattan, N. Y. The invention refers more particularly to a device which comprises a head, a clutch carried thereby and adapted to receive and grip the end of the pin near the point thereof, and a cushion point protector carried by the head and adapted to receive the point of the pin.

ATTACHMENT FOR DISPLAY FIGURES.—W. H. BEYETTE, 703 Dallas St., Houston, Tex. This figure is such as employed in sales rooms and stores for displaying garments, and the particular purpose of the inventor is to provide an attachment which may be removably placed upon the figure in order to display the garment to advantage.

ANTISLIPPING DEVICE.—W. FINDLAY, 107 Bodine St., Long Island City, N. Y. This device is to be worn on the sole of a shoe and is provided with means for its easy removal and replacement, and also for its reversal so that when worn from one side it may be turned over so as to expose the fresh antislipping surface to the ground.

DRESS WEIGHT TAPE.—A. WEIN, care of American Toy Works, 7-8 Chatham Sq., New York. The object here is to provide an improved dress weight tape arranged to permit its convenient attachment to the garment (skirt, draperies and the like) and to provide weights of uniform size and regularly distributed along the tape.

Pertaining to Aviation.

AEROPLANE.—F. C. LAMBERT, 1883 Bathgate Ave., Bronx, N. Y. This aeroplane provides a large sustaining surface for carrying a heavy load, to enable the aviator to readily maintain the equilibrium and thus avoid undue swaying, and to permit easy control of the sidewise steering means and the raising and lowering means.

Electrical Devices.

BURGLAR ALARM ATTACHMENT.—G. A. BREWSTER, 3 S. Elliott Pl., Brooklyn, N. Y. One of the principal objects of this invention is to provide a convenient attachment for insertion between the sashes of a window or between doors and frames therefor and other closure members and the frames for the same.

WATER AND SEWAGE LIFT.—A. C. WELLS, of Wells & Newton, Ave B, 17-18 Sts., N. Y. The lift has a conduit leading to a tank with an inlet and an outlet and valve means controlled electrically for connecting the conduit with the atmosphere when the tank is filled for forcing the sewage through the outlet.

CURRENT MOTOR.—J. H. MARTIN, 615 W. Lynne St., Springfield, Mo. This invention provides a simple, economical current motor adapted to be arranged in a running stream or the like, and wherein means are provided for utilizing the force generated by the moving water with as little waste from friction as possible.

PORTABLE FAULT-FINDING DEVICE FOR ELECTRICAL IGNITION APPARATUS.—S. P. HEDGES, 13 Main St., Greenport, N. Y. This appliance determines the fault or trouble with electrical ignition apparatus of internal combustion engines, such apparatus, for example, as the spark plugs, wiring and spark coils. The inventor's aim is to enable the test of the several factors of the apparatus at both atmospheric, compression and other pressures.

Of Interest to Farmers.

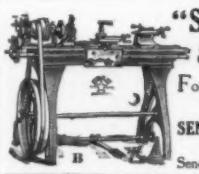
CULTIVATOR.—C. W. GIFT, R. D. No. 2, Box 24, Waynesboro, Pa. The invention in this case has for its object to provide a simple, inexpensive hand operated cultivator device, wherein means is provided for swinging the supporting wheel on a vertical axis to guide or steer the plow laterally.

Of General Interest.

DEVICE FOR COLLECTING SAMPLES OF FINELY DIVIDED MATERIAL.—J. N. REED, care of J. I. De Almagro, Obrapia 32, Havana, Cuba. This invention consists more particularly in a portable apparatus for the collection and separate conveyance of the greatest possible number of samples of material by one operator without much inconvenience, so as to afford the greatest guarantee of the character and condition of the material contained in each bag from which samples have been collected for examination.

UMBRELLA.—T. SUSEMIHL and C. CARRINGTON, care of T. Susemihl, 1796 Fulton St., Brooklyn, N. Y. This improvement relates to umbrellas, the more particular purpose being to provide the umbrella with improved means whereby it may be disassembled and compacted into a small space and carried in a small case for the purpose.

EXPANSION BOLT.—H. W. MUNGER, 2183 Amsterdam Ave., New York. In this patent the intention is to provide a new and improved expansion bolt, more especially designed for use in concrete and similar plastic material constructions, and arranged to permit of securely fastening other parts to the concrete construction.



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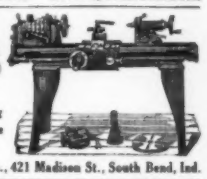

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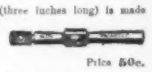

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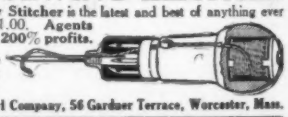

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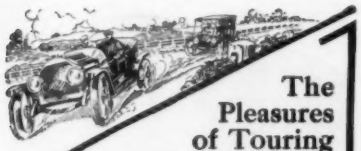

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WINDOW INSERT FOR UMBRELLAS.—R. C. FLUES, 455 Richmond Road, Richmond, S. I., N. Y. This inventor provides an umbrella with a transparent section through which a view may be had by the carrier while the umbrella is held lowered to fend against a storm; and provides transparent sections to be inserted in the umbrella structure, readily and quickly.

METALLIC FLEXIBLE HOSE PIPE.—B. M. PECHSTEIN, Spiegelstrasse 9, Zwickau, Saxony, Germany. This invention consists in forming the hose with a smooth interior surface preferably formed with a flat spirally wound band. This lining band can either form a separate part in itself or may be in the form of an overlapping portion which is an extension of the band which forms the hose, this band and overlapping portion consisting of one piece. This hose is suitable for transporting corrosive liquids and the like. The invention remedies defects in transporting granular material, and especially improves on the hose formerly used in connection with distilleries or yeast manufactories.

Hardware and Tools.

WEIGHING APPARATUS FOR REFRIGERATORS.—F. B. HARRINGTON, Box 274, Elk City, Okla. Mr. Harrington's invention is embodied in a weighing apparatus adapted for convenient use within an inclosure such as a refrigerator or ice box, the same being provided with means for attaching it to, and supporting it upon, the inner walls of the receptacle.

CONVEYER CLEAT.—F. E. TUXWORTH, Fullerton, La. The principal purpose here is to provide a new form of cleat which is adapted to be positioned in any one of the links of a chain whereby the chain and cleats may be used for conveying articles through a suitable conveyer or chute.

HOSE COUPLING.—V. SANPHY, Box 123, South Bend, Wash. This invention relates to hose couplings, and its object is to provide one having a coupling member with an inner thread in which a threaded sleeve meshes, there being a propeller blade in the sleeve, adapted to be operated by the fluid passing through the hose for pushing the sleeve against the shoulder on a companion coupling member.

GRANITE CHISEL.—J. H. JENKINS, 111 E. Gambier St., Mt. Vernon, Ohio. This invention refers to stone-working tools, and more particularly involves an improved granite surfacing tool. The chisel is of simple construction and few parts, having means for holding a plurality of blades securely in position, the device presenting a form which is extremely efficient in operation.

RELEASING DEVICE.—C. MULLER, 1198 Franklin Ave., Bronx, N. Y. This device is preferably for use in releasing halters of one or more horses or other domestic animals, to enable them to be led out of a stable or other building in the shortest space of time in case of the outbreak of fire. It may be employed in suspending lifeboats from davits on shipboard and in many other uses.

SPIRAL TOOL DRIVER.—M. WOLIN, 653 Second Ave., Manhattan, N. Y. This invention has reference in general to a new and improved form of blade sharpener, and an object of his inventor is to provide a spiral screwdriver which may be arranged to rotate a tool in either a clockwise or anti-clockwise direction.

BLADE SHARPENER.—J. E. MORSE, 241 N. Pleasant St., Canandaigua, N. Y. Mr. Morse's invention has reference to a new and improved form of blade sharpener, and an object of his invention is the provision of a sharpener having removable cutting tools with duplicate edges which may be removed and ground at will.

Heating and Lighting.

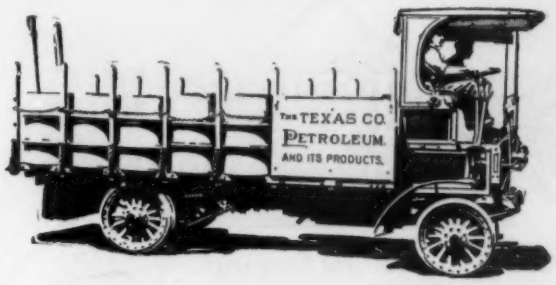
SWITCH FOR PROGRESSIVE LIGHTING.—G. T. FIELDING, JR., 2969 Decatur Ave., Manhattan, N. Y. In this instance use is made of a series of electric lamps and a switch for each lamp, controlled by the current of the preceding electric switch, so that after one lamp is lighted the next following one is automatically lighted at a predetermined interval, and so on, throughout the entire series of lamps.

TOOL FOR HANDLING ELECTRIC GLOBE LAMPS.—A. SANTILLI, N. Y., assignor to G. Moretto, 13 Charlton St., New York. This invention provides easily operated means for gripping and holding the globe of an electric lamp at the end of a rod, whereby it may be inserted in, or removed from elevated sockets; and provides gripping means for the globe, certain in action and delicate in operation.

METHOD OF MAKING REFLECTORS.—L. KAUFFELD, care of Star Glass Co., Star City, W. Va. This invention relates to a new and improved method of making reflectors for lamps of any character, such as electrical or gas. An object of the invention consists in a new and improved method of manufacturing a hollow curved reflector.

ELECTRIC GAS LIGHTING AND EXTINGUISHING APPARATUS.—THE IDEAL EPWORTH ACETYLENE CO., Johnstown, Pa. This invention provides a gas lighting and extinguishing apparatus, the workable parts of which are inclosed in the gas chamber itself, thereby eliminating the necessity of providing an opening which must be made gas tight, and which at the same time must be lubricated.

METER CONNECTION BOX.—F. C. GRADY, 1519 S. State Ave., Indianapolis, Ind. This inventor provides a form of box suitable for



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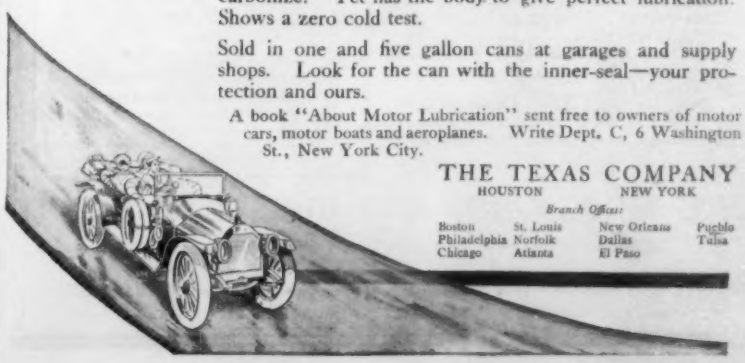

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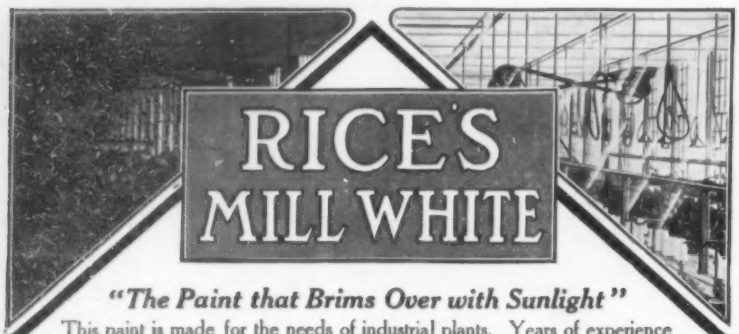

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Motz Cushion Tires in Tests of Efficiency Eclipse Both Pneumatic and Solid Tires

You know Motz Cushion Tires are **trouble-proof.**

You know they are **easy-riding.**

But do you realize that any motor car, on a given charge of fuel, will travel farther equipped with MOTZ TIRES than with pneumatic or solid tires?

It's a fact.

Makes no difference whether your car is electric driven or gas driven,

—or what make it is

—or what kind of light delivery duty it performs

—or what kind of streets it is driven on

—or what kind of tires you are now using.

—put Motz Cushion Tires on it and you will get more miles' service per battery charge or per gallon of gasoline than you ever got before.

You'll get more miles of tire service, too!

You'll get a **guarantee** of 10,000 miles—two years.

And you won't ever be bothered by punctures, blow outs or rim-cuts.

You won't have to carry an extra tire, either.

And the mechanical parts of your car will get the same protection from bumps and jolts as pneumatic tires give.

For Motz Cushion Tires are every whit as easy-riding as properly inflated pneumatic tires.

They have double, notched treads, which prevent skidding and distribute weight to the side. The undercut sides allow free action of bridges. The slant-wise elastic bridges yield like air in pneumatic tires.

Note, too, that Motz Cushion Tires fit any standard clincher, universal quick-detachable, or demountable rim.

* * * * * * *

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Gives utmost service with no repair expense—easy-riding and protects your car—gives low cost of hauling—is easy to apply.

What more could one ask or want?

Write for our Booklet 93, mentioning make and model of your car and we will be pleased to give you the name of our nearest agent.

For heavy trucks, where load, not speed, is the principal factor, we recommend Motz Solid Tires on Demountable Rims.

MOTZ Cushion Tires

Best Equipment for Light Delivery Commercial Cars

A—Shows double, notched treads.
B—Shows undercut sides.
C—Shows slantwise bridges.
D—Shows absorbing means when passing over an obstruction.

(224)

THE MOTZ TIRE AND RUBBER COMPANY

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BRANCHES: New York, 1737 Broadway; Chicago, 2023 Michigan Ave.; Detroit, 999 Woodward Ave.; Kansas City, 409 E. 15th St.; Cleveland, 2352 Euclid Ave.

Standard Tire & Rubber Co., 104-106 Portland St., Boston, Mass., Distributors for the New England States

connecting wires, or analogous electrical conductors with electric meters, his improvement being especially adapted to facilitate the making and breaking of connections for a number of distinct purposes associated with meters.

Household Utilities.

COMBINATION CHAIR AND COUCH.—P. F. MCCAFFREY, 175 Eckford St., Brooklyn, N. Y. The object here is to provide a chair and couch arranged to permit the user to readily and quickly convert it from a chair to a couch or vice versa. The frame consists of a middle, a foot and-seat, and a head and back sections. The foot and seat section can be swung into extended position, or when desired to use the piece of furniture as a couch, or it may be swung into folded position on top of the middle section when in use as a chair.

SUPPORTING ATTACHMENT FOR ICE CREAM FREEZERS.—ISABELLA G. HOPKINS, St. Augustine, Fla. This invention provides a device which can readily be attached to the ordinary freezer, so that the latter can be conveniently positioned for use, and which is provided with a spout through which the overflow caused by melting ice can easily be drawn off.

CLOTHES LINE REEL.—DR. F. EICHE, 1205 O St., Lincoln, Neb. This improvement is embodied in a wall bracket provided with a journal serving as a support for the reel, and in the construction and arrangement of a pawl attachment of the ratchet reel, whereby such attachment normally holds the reel on the bracket journal, but may be adjusted to release the reel from the journal, or free the pawl from engagement with it.

Machines and Mechanical Devices.

CLOTH CUTTING MACHINE.—A. MERHIGE and C. F. COOKSON, 421 43rd St., Brooklyn, N. Y. This invention provides a machine arranged to permit of conveniently following curved lines in cutting the material, to permit of readily adjusting the presser foot relative to the thickness of material to compensate for unevenness in the thickness, and to insure proper entering of the base under the material to be cut.

EXHAUST CONTROLLING MECHANISM.—S. S. STEVENSON, Evansport, Ohio. This invention is for use on steam engines, and its object is to control the exhaust in such a manner as to secure a certain amount of back pressure upon the cylinder so that steam will be retained in the cylinder to form a cushion therein.

CLAY CLEANING MACHINE.—B. JACQUART, South River, N. J., and J. V. V. BOORAEM, New York, N. Y., care of American Enameled Brick and Tile Co., 1182 Broadway, New York, N. Y. This invention relates to machines employed for separating pebbles, small stones and various other hard impurities from large masses of mined clay, in order to render the clay plastic and suitable for bricks, earthenware members, etc.

THREADOMETER.—C. A. HAMMOND-KNOWLTON, 817 Broadway, New York, N. Y. This instrument embodies a series of registering disks which are driven by the thread-wheel, and are mounted on a setting device by which the disks are readily returned to starting position, the instrument being compactly built, with disks and adjacent parts within a close-fitting case through which the reading of the meter is conveniently presented.

WINDING AND MEASURING MACHINE.—F. MCL. BROOKS, Fayetteville, Ark. This machine is arranged to facilitate the unwinding of a piece of screen wire cloth or other fabric from a roll, to measure the unrolled portion according to the length desired by a customer, to rewind the unrolled piece, and cut it off from the roll at any length, and to allow splicing the end of a fabric roll to a previous roll remnant.

POWER TRANSMISSION MECHANISM.—H. FÖTTINGER, Zoppot, near Danzig, Germany. In order to avoid losses on the occurrence of negative pressures in the transmission mechanism, and to avoid the formation of hollow spaces which result, the inventor places the working chamber under pressure, which he finds can be done without any disadvantage to the mechanism. This can, for instance, be effected by a pump, an elevated vessel, or other suitable means.

PICTURE EXHIBITING APPARATUS.—C. L. THONSEN, Wodrofsplads 14, Copenhagen, Denmark. In this patent the invention concerns an apparatus for the automatic exhibition of alternating transparent pictures and advertisements. The invention specially applies to an apparatus which automatically, at suitable intervals, exhibits a fresh picture.

PIANO CASING.—F. RENEK, 358 Jamaica Ave., Astoria, Queens, N. Y. The object of this invention is to provide a piano having a mechanism for opening and closing the panel and for moving the pedals for the bellows into an active or a folded position, on the operator opening or closing the casing for the controlling mechanism of the player piano.

Railways and Their Accessories.

PACKING RING.—W. TESCHEMACHER, 24-26 Hafenstrasse, Werden-on-the-Ruhr, Germany. This invention pertains to journal bearings for car axles and the like, and the object is to provide a new and improved arrangement for rendering the bearing dustproof and to insure uniform pressure on the split or open packing ring for the purpose.

METALLIC RAILROAD TIE.—T. T. TONG, Box 119 Gordon, Neb. This inventor provides a metallic tie which is simple and durable in

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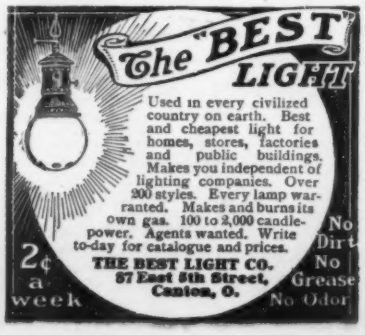
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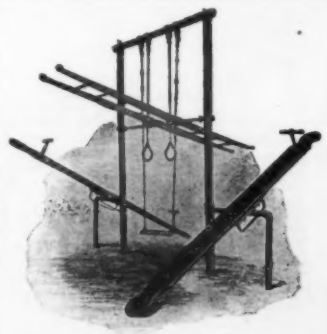

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construction, cheap to manufacture, and arranged to permit of quickly and securely fastening the track rails in place to keep them from spreading.

GUARD RAIL.—P. D. SERRURIER, Savanna, Ill. An object of this inventor is to provide a guard rail for railroad or car track which may extend under the rail proper, and be secured to the opposite side thereof, so that it cannot be readily turned over or be pulled out, and is so formed that it will not be liable to catch the foot of a track walker.

Pertaining to Recreation.

TARGET BOARD.—G. W. FERGUSON, 45 Pleasant Avenue, Oshkosh, Wis. The invention is especially adapted for children and provides a target made up of a board having channels on the rear thereof, there being an opening in the board between the channels, the latter maintaining in successive positions a number of elements having pictures thereon, the element in exposed position being adapted to be dislodged from view by being struck with a missile where the next succeeding element comes into view.

DANCING FIGURE.—W. J. NICKERSON, 120 North Galvey Street, New Orleans, La. This figure is adapted to be manually used on the keyboard of a piano, organ or other key-actuated musical instrument, to cause the articulated members of the figure to move on playing certain keys and in rhythm with the music produced.

Pertaining to Vehicles.

MUD GUARD FASTENER.—A. S. HALL, West Side Public Sq., Kokomo, Ind. This invention comprises a fastener made of strong resilient material so designed as to engage part of the frame of the vehicle at one point and the mud guard at other points, to secure the guard in proper position.

ANTISKID DEVICE.—D. J. MARTIN, 20 East 120th St., Manhattan, N. Y. An object of this inventor is to overcome the difficulty of wear on the working tread by constructing a chain which as soon as it is somewhat worn on the tread, may be fed on one side, thereby presenting a new unworn portion of the chain to the wearing action between the tire and road surface.

TRUCK.—S. BOTTEESE, 1431 Corcoran St., Washington, D. C. This invention is an improvement in vehicles, which improvement may be embodied in wagons or trucks and is here embodied in a truck adapted for use in department and similar stores where it is desired to carry a number of packages from point to point.

TAXIMETER CONTROL.—J. D. SULSONA, 38 Park Row, New York. This invention relates to a device for controlling the taximeter on a taxicab or other vehicle with the aid of an alarm, so that the taximeter cannot be comfortably maintained in its non-registering position when the vehicle is occupied by a passenger.

Designs.

DESIGN FOR A LOCKET.—C. DAILEY, care of Klein & Sons, 14 Park Pl., New York, N. Y. This ornamental design comprises a locket between whose cases is a flat centerpiece with one side bearing a figure of Jesus with a sacred inscription on the margin, and a holy mother and child on the opposite side. Mr. Dailey has designed another locket representing on its two interior surfaces figures of Jesus and the Virgin Mary with sacred quotations circling the edges.

DESIGN FOR A KNIFE HANDLE.—A. W. WILLIAMS, 1790 Beacon St., New York. This design of a knife handle has a very simple yet attractive outline of a long oval form with a small ornamental pattern at each end of the handle which gives a simple and effective ornamentation.

DESIGN FOR A BRACELET WATCH.—E. J. WITTNAUER, care of A. Witnauer & Co., 28 W. 36th St., Manhattan, N. Y. This ornamental design for a bracelet shows a small watch in its center. The form of the article is oblong and tapering to the ends which hold the narrow band that circles the arm. The surface of the body holding the watch bevels gracefully from the dial to the edge.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We are prepared to render opinions as to validity or infringement of patents, or with regard to conflicts arising in trade-mark and unfair competition matters.

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But the diagonal stroke is the thing; all razor makers admit it. It is not a matter of preference, it is the only way to get a real shave.

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Any-Angle Razor

Note the pictures—a touch tilts the blade and there is your slanting stroke!
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Try the Any-Angle Razor.

Your money back without a word if dissatisfied after a thirty-day trial.

All dealers are authorized to refund your money if you use the Any-Angle Razor 30 days and do not like it. If your dealer cannot supply you, send the price of the razor to us with same return privilege. The price of the Any-Angle Razor and 12 keen blades, in rich, genuine leather case, is **$3.00**

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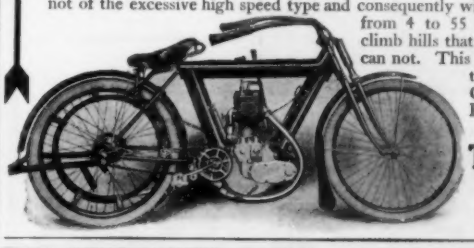

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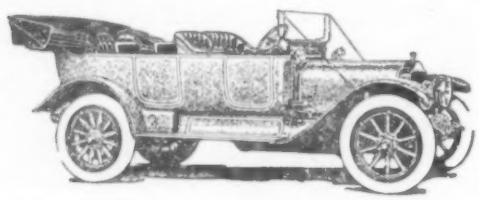

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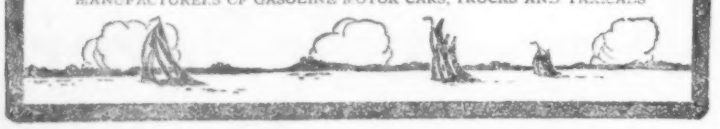

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AT VERY SMALL COST

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Just as easy as it sounds. We will sell you one of these wonderful Motorgo Engines direct from our factory, and you can install it in your boat in a few hours' time. No need at all of a mechanic. You can do the installing yourself. We guarantee that positively.

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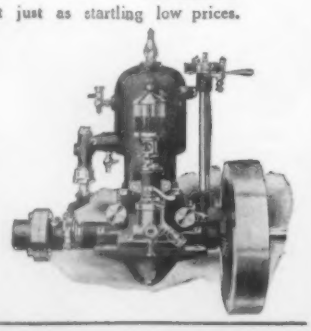

SEARS, ROEBUCK AND CO., CHICAGO

Gun versus Armor

(Concluded from page 448.)

ship. The condition of this framing shows how terrific would be the destruction wrought by high-explosive shells within the interior of an armored ship.

The other views, showing the attack (also by the army 12-inch gun) on a modern Krupp plate are even more significant. In the first place this plate embodies the improvements in manufacture during the twelve years intervening since the "Iowa" experiments; and in the second place the plate is 18 inches in thickness, an increase of more than 50 per cent over the earlier plate. It will be noted that the plate was clearly penetrated and badly cracked.

The victory, then, in this long-drawn-out contest lies to-day conclusively with the gun.

The point has been raised that the projectiles which fall short of but near a ship, may pass through the water and explode in contact with or sufficiently near the hull of the ship below her armor to cause serious damage. To test this, a steel caisson was built and tested at Sandy Hook, when a 12-inch shell was hung below the water near the side of the caisson and exploded. The results, a lofty column of water thrown into the air and badly dished and ruptured plating, proved that the effect of such shells bursting under water would be similar to the action of the mine and the torpedo.

Guns of the Coast-Defense

(Concluded from page 441.)

of a structure back of the battery. From this point, with a clear range of vision, the commander controls the fire of his battery, as explained in a previous chapter. Below him and behind the shelter of the battery parapet is the plotting room, in which the corrected ranges of the guns are worked out and telephoned to the guns. Beyond at the ends of a long base line are two observing stations *B' B"*. From these stations the respective angles made by the base line and the respective lines to the ship are telephoned, at 15-second intervals, to the plotting room.

The modern steel mortar is built up like the high velocity, direct-fire gun, of an inner tube, strengthened by shrinking on a jacket and hoops. It is mounted on a special carriage which enables it to be fired between angles of 45 and 65 degrees. Each mortar is about 12 feet long and weighs about 14 tons. It fires its projectile with a far lower velocity than the long, direct-fire, high-velocity gun—less then one-half, in fact. The shell, 3½ feet in length, contains 100 pounds of high explosive. It is thrown to a height of several miles into the air, and the angle of elevation at which it leaves the gun, the weight of the shell, its velocity, etc., are so calculated and related, that it will reach with remarkable accuracy a ship six or seven miles distant and descend upon it almost vertically—a literal "bolt out of the blue!"

Mortars can be even more effectually concealed than direct-fire guns; for direct vision is not necessary. The mortar pits may be constructed somewhat remote from the water—in some deep sheltered valley, if so desired. They are rectangular, concrete-lined excavations 60 to 70 feet deep, arranged in groups of four with connecting passage-ways. In each pit are four mortars. The batteries can be discharged in salvos of four, sixteen, or even thirty-two, if that number of mortars is available. A rain of 32 twelve-inch, high explosive shells, falling about a ship from a height of several miles, would mean, it is believed by our Coast-Defense Officers, the making of a sufficient number of hits to completely disable the ship.

Coast-Defense of the United States

(Concluded from page 439.)

tempting to enter any of our harbors where mortars are installed—provided conditions permitted accurate observations. Mortars are not as accurate in their fire as guns, but four are fired simultaneously, and sometimes eight, or even sixteen, and the slight variation in range due to irregular powder, or intentionally slight variation in laying, would cover a given portion of the channel so effectually that it would mean disablement to any craft entering the zone of fire. One or at most two mortar projectiles at mid or long range would end

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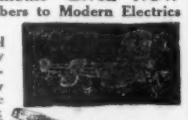

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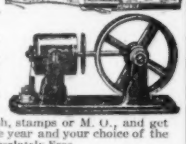

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the career of the heaviest ship afloat as a fighting unit.

"How accurate is mortar fire?" asks Capt. Howell, and he answers: "I have seen them fired singly when the projectile from one gun fell within five yards of a standard target 12 feet square, and another projectile fell within 10 yards, while many of them fell about the target within the area of a ship's deck, and one fell on the flagstaff of the target."

As an example of what has been done in the matter of fire command service practice for direct fire, even before the full development of the present approved system of installation and control, reference is made to the work of a group of six batteries of 8-, 10-, and 12-inch guns at Fort Monroe, July 22nd, 1905.

The officer commanding had been but a few days with the batteries; so the credit of the work must be largely given to the enlisted personnel, their regular officers, and the fire commander. Different lots of powder were used; ranges were not known, except as they were determined by the position-finding system; it was not known when any battery would be directed to fire; and the course of the targets was in the shape of an irregular figure eight at a constantly irregular variation in range. Forty-one shots were fired, not in a continual string but in irregular series of one, two, or three shots from a battery at a time; or a concentration of two, three, or four batteries firing on one target one, two, or three shots as ordered. Two of these batteries made a score of 75 per cent of hits, the others varied from 43 per cent to 62 per cent, resulting in a general average of 60 per cent. Under the practice order, the width of target allowed for scoring a full hit was 75 feet, height 24 feet. The strike of each shot was carefully observed from shore and from the tug and recorded and compared, and the record was finally compiled by Maj. E. M. Weaver, A.C. The accuracy of the record is not open to question.

In conclusion, it should be noted that the great accuracy of coast-defense fire is due, first, to the accuracy of the position-finding instruments, the long base line and the consequent accuracy of range as determined; second, to the fact that the gun platform is stationary and absolutely quiet.

Permanent Life of Tissue Outside Its Organism

THE life of a tissue (as of heart, or spleen, or muscle) taken from the body and cultivated *in intro*—that is, in a glass receptacle, such as a bowled slide—is in general very short: in from three to fifteen days its growth becomes less rapid and eventually ceases altogether; it then dies and its cells degenerate. Dr. Alexis Carrel has made many memorable experiments to the end of prolonging such tissue life; he now, in *The Journal of Experimental Medicine* of May, 1912, describes the work he has done to determine the conditions under which the active life of a tissue outside the organism could be indefinitely prolonged. By various remarkable techniques he has been able to maintain such tissue cultures in active life for beyond sixty days, in some cases at least eighty-five days. His results have shown that the early death of tissue cultivated *in intro* is preventable; and that, therefore, their permanent life is not impossible. To the biologist the statement is most important—that it is possible, by means of the various techniques which Dr. Carrel has evolved, to study the morphological and dynamic character of tissues thus cultivated outside the organism.

Omnis cellula e cellule is the basal dictum; whatever is nebulous about the origin of life, biological science has, in the present state of its development, established that all life originates in a cell and that all life development and continuance is by cell reduplication. It is, then, more than interesting to note that in Carrel's experiments cells are seen to grow from the tissue and to multiply into the medium surrounding it *in intro*. It is absolutely certain that the cells multiply and that they do not merely wander from the central tissue, because a few proliferated cells that are scattered themselves generate other cells.

Another momentous phase of Carrel's work was to ascertain whether tissues after a long period of life *in intro* could retain their normal functions. He was able to demonstrate that a fragment of

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Before St. Louis Fire Prevention Bureau and St. Louis Fire Department on March 19, 1912

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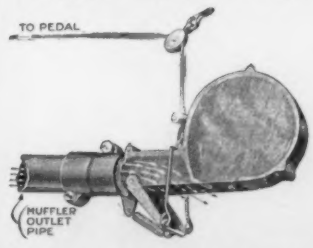

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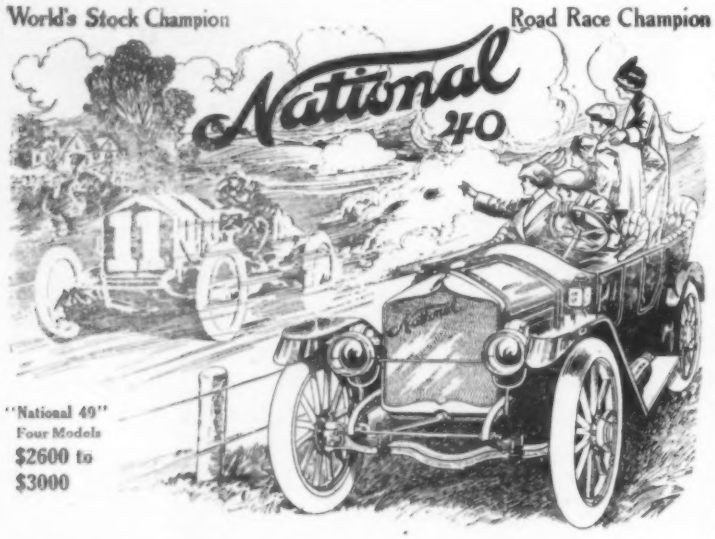

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chicken heart could still pulsate rhythmically at the beginning of the third month of its existence outside the organism. One must conclude therefore that a fragment of tissue living *in intro* can for a long time retain its normal function.

Another fact of interest to the biologist (and to the evolutionist interested in "adaptations") is that the transferred tissues seem to have adapted themselves to their new conditions. Very few cells died spontaneously *in intro*. The rate of the growth in the cultures was markedly influenced by a number of factors—the nature of the medium, its osmatic tension, "the way in which the plasma was cut, the amount of old plasma left around the cells," the form of the culture and the frequency with which the changes from one to another medium were made. We note also that in the handling and changing required in the various techniques the cultures were exposed to many accidents, chiefly to microbian infection. One wonders (from a practical viewpoint) how many more accidents and how much more infection there would be under manipulations less skilled than such as Carrel's. Many cultures, he notes, died of sepsis. Here as in life generally the deadliest enemy to existence, both macroscopic and unicellular, is the infection-breeding bacterium, which itself is oftentimes ultramicroscopic in size (that is, at present not detectable by any known means) and recognizable only by its virulence and its deadly effects. It is, then, Carrel's conclusion that experiments such as his, followed over long periods of time, may lead to the solution of the problem of permanent life of tissues *in intro*, and give important information on the characters acquired by tissues liberated from the control of the organism from which they were derived.

Unusual Occupations

WHEN the thirteenth census is completed, that is when the last compilation has been made and each individual has been put in the proper class, it will be the most exhaustive classification ever made by the Census Bureau. For instance, while machinists will of course be placed under one general heading, each of them will be classified according to the particular work he is doing, and so with other trades and industries. Some of the sub-classes will contain but a single name. This will bring to light a number of queer ways in which some people are engaged in earning a livelihood. As far as the work has progressed, there is only one man classed as "snake merchant." This man has a snake ranch in Texas, and has for more than seven years made a business of handling snakes. During the year 1910 he sold over 150,000 rattle snakes and black snakes, the prices ranging from 25 cents to $2 each. They are sold to zoos, side shows of circuses, medical colleges and scientists.

Under the shoe industry one would hardly expect to find persons sub-classed judgers, fakers, plowers, sluggers, busters-out, cripple chasers and pancake makers, but there they are. Another man who will be all in a class by himself when the work is finished is a resident of Kansas City. His sole business is to bottle smoke of burning hickory logs. He claims that when this smoke is let loose in an airtight compartment where meat has been hung it will produce the same results upon the meat as though it had been smoked in an old-fashioned smoke house. Such titles as "whittler," in a straw hat factory, "tobles," a maker of stogies, "dock walloper," a longshoreman, "pouncer" in a hat making establishment, "vibrator" in a clock factory, "tonger" in connection with oysters, "teaser" in a glass factory, are some of the other queer designations used by the Census Bureau.

Indeed there are as many women as there are men who pursue odd ways of earning money, one class of which would be designated as "goats," were a common expression of the times used, for it is their business to be "discharged" from the department stores in which they are "employed" a number of times each day, or as often as necessity might demand. When a grouchy or haughty customer makes complaint of discourteous treatment, or what not, against a clerk one of the "goats" is summoned to the office as the person in charge of that particular department. There she is given a good talking to before the angry customer and summarily dis-

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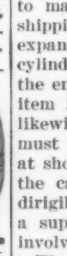

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missed, and the complainant goes away rejoicing.

Women policemen are becoming rather commonplace. We have a woman chief of police in Kansas; a town in Pennsylvania boasts a fair deputy sheriff, who is a college graduate, and Los Angeles was the first city to appoint a woman to its police force.

One woman in Pennsylvania earns her daily bread by raising Persian cats and selling them for from $25 to $100 each. She not infrequently makes large sales to wealthy cat fanciers. Still another woman in Maryland devotes her time to pigeon raising, claiming her income from the industry to be about $700 a year.

One of the most unique trades of the entire list, however, is that carried on by a man in Seattle. His business, and a profitable one, too, is to secure the mustaches from walrus killed in Bering Straits and sell them to the Chinese for toothpicks. These stout bristles are plucked from the nose of the walrus by Indians, tied into small bundles and sold by him on the Pacific Coast to agents who ship them to China, where they are in great demand. In an aged bull walrus the bristles are about a foot long and nearly as thick as a lead pencil. Besides being extremely tough, they can, when made into picks, be pushed between the teeth without injury to the enamel. Last year this dealer cleared something like a thousand dollars by his traffic in walrus whiskers.

Hydrogenite: Portable Hydrogen-producing Briquettes.

THE usual methods of generating hydrogen, either by electrolysis or the passing of super-heated steam over incandescent coals, is simple enough, and not expensive, since the source of supply is water. But the apparatus required is somewhat cumbrous, hence the need of shipping the gas from plants where produced to the points where needed.

But the very quality which gives hydrogen its chief commercial value, i. e., its buoyancy, or bulk in proportion to weight, makes this an expensive affair.

It is necessary for the gas to be compressed by a pressure of 120 atmospheres to make it convenient for handling and shipping. This of course so increases its expansive power that very strong steel cylinders are necessary to confine it, and the enormous weight of these is a serious item in freight charges. This weight is likewise a great drawback where the gas must be transported from place to place at short notice by automobile, as is often the case in military and other uses of dirigible balloons. It is estimated that a supply of only 4 cubic meters of gas involves a freight of 30 kilogrammes.

These considerations have induced much experiment in the hope of discovering some practicable means of generating hydrogen otherwise than by water and the requisite plant.

While the experiments of Majert and Richter in this direction were crowned with success from a scientific standpoint as early as 1886, their method never overcame technical difficulties so as to be commercially useful.

Very recently, however, a French chemist, Dr. Jaubert, has achieved admirable results by a new process. This consists in the mixing of ferro-silicon with caustic soda and calcium hydrate to form a powder which he terms "hydrogenite." This powder is compressed into briquettes which are not very heavy and are easily carried from place to place.

They are combustible, but non-inflammable, burning when ignited without flame. The combustion consists of a readjustment of the constituent elements by means of which free hydrogen is liberated.

Only the silicon of ferro-silicon plays a part in the reaction, uniting with the sodium, calcium and oxygen of the calcium hydrate and the caustic soda, while the hydrogen is isolated.

The combustion must of course take place in a suitable apparatus, which, however, is not elaborate, expensive, or heavy.

The technological advantage gained lies in the fact that 12.5 kilogrammes of the hydrogenite furnish 4 cubic centimeters of gas. Allowing for the average weight of the required combustion apparatus, the method permits a saving of about 50 per cent transportation freight.

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If all that is claimed for hydrogen be true it ought to materially assist the proposed attempts at ocean-crossing by means of dirigible balloons.

Curious Lightning in the Andes

DR. WALTER KNOCHE, the German director of the Chilean meteorological service, has begun an investigation of the remarkable displays of so-called "heat lightning" which are often observed along the crest of the Andes, and are sometimes visible far out at sea. (In one case Dr. Knoche saw them from Easter Island, 300 miles from the Chilean coast.)

Thunderstorms are rare in Chile, and this fact may possibly be explained on the assumption that the Andes act as a gigantic lightning-rod, between which and the clouds silent discharges take place on a vast scale. The visible discharges occur during the warm season, from late spring to autumn, and appear to come especially from certain fixed points. According to Dr. Knoche they are confined almost exclusively to the Andes proper, or Cordillera Real, as distinguished from the coast cordillera. Viewed from a favorable point near their origin there is seen to be, at times, a constant glow around the summits of the mountains, with occasional outbursts, which often simulate the beams of a great searchlight, and may be directed westward so as to extend out over the ocean. The color of the light is pale yellow, or rarely reddish.

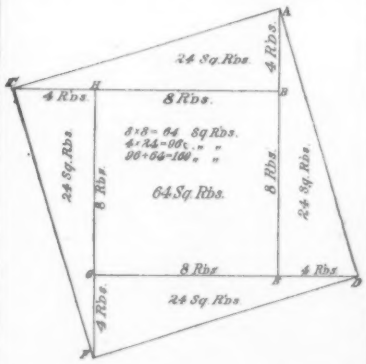
One striking feature of these discharges is that they are especially magnificent during earthquakes. At the time of the great earthquake of August, 1906, throughout central Chile the whole sky seemed to be on fire; never before or since has the display been so brilliant. The natives regard these lights as the reflection in the sky of the glowing lava in the craters of volcanoes; but there seems to be no doubt that they are electrical discharges.

It is planned to make spectroscopic observations of this singular phenomenon, and also, if possible, measurements of the electrical state of the atmosphere in the high Andes where it appears to have its origin. Possibly the result may be to connect up "Andes lightning" with a peculiar form of aurora which has been observed by Lemström over mountain summits.

How to Lay Off a Square Acre

By H. M. Varn

AN acre contains 160 square rods, therefore one side of a square acre should be the square root of this. As the square root runs into many decimals some indirect method has to be found of obtaining the proper measurement. The drawing below will make clear one of the most ingenious methods and one very little known to any but old line surveyors.



First a square eight rods on a side is laid off. Then from each corner one side is extended four rods more. These last ends are now connected and an absolutely square acre is the result. From the drawing this is evident; for the inside square contains 64 square rods and each triangle contains 24 square rods (base times one-half the altitude or $12 \times 4/2$), so four times 24 is 96, this added to 64 gives the requisite 160. It will be readily seen that the placing of the pegs outlining this square acre is an easy matter, for they each come at the end of a certain rod on the chain.

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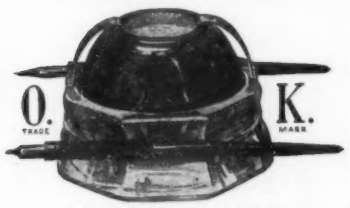

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THE WORLD'S MINERALS. By Leonard J. Spencer, M.A., F.G.S. New York: Frederick A. Stokes Company, 1911. 12mo.; 272 pp. Price, $2 net.

At last we have an illustrated book on mineralogy worthy of the name. This excellent science has suffered very much in the past by the absence of properly illustrated books. We do not know of any properly executed color plates in any book except Kunz's "Gems and Precious Stones of the United States." The present volume gives a complete treatment of the minerals of the world, by the reading of which anyone may acquire a considerable knowledge of the science of mineralogy.

Mr. Spencer takes up the forms of minerals, crystals with all their interesting formations, colors of the various substances, their fracture and cleavage, the chemical composition and classification of minerals, and finally the minerals themselves in scientific sequence. Such interesting substances as the ores containing radium, and the precious stones, are fully treated. The colored illustrations, on account of the lithographic process of printing, are similar to the illustrations in "Birds of the World for Young People" and "Animals of the World for Young People," issued previously. They are unusually accurate, having been prepared under the direction of an expert from the British Museum.

MODERN PRACTICE IN MINING. Vol. IV. The Ventilation of Mines. By R. A. S. Redmayne, F.G.S. New York: Longmans & Co., 1911. 8vo.; 231 pp.; illustrated. Price, $2.10.

This is the fourth in a series of five volumes, the others being: Vol. I, Coal: Its Occurrence, Value, and Methods of Boring; Vol. II, The Sinking of Shafts; Vol. III, Methods of Working Coal; and Vol. V, The Mechanical Engineering of Collieries. The author is His Majesty's Chief Inspector of Mines (Great Britain), and his position vouches sufficiently for the authority and value of the work. In this, the fourth volume, the mining student will find many-sided information on the ventilation of mines—information that he would otherwise have to consult several separate works in order to acquire. The production of firedamp, carbon dioxide, carbon monoxide, after-damp, sulphureted hydrogen, and nitrous oxide is the subject of careful investigation and deduction, as are also the circulation of air-currents, the frictional resistance of the air-ways, the instruments used in air measurements, the production of the ventilating current, and, finally, colliery explosions and gob fires. Much of the apparatus in use is shown in illustrations, of which more than a hundred make for the elucidation of the text and enhance the value of the volume. Folders give the ventilating plan of a seam worked on the bord-and-pillar system, and a ventilating chart of the East Rand Proprietary Mines. As an exposition for students' use the information is commendably planned and imparted.

WHO'S WHO IN SCIENCE. (International) 1912. Edited by H. H. Stephenson. New York: The Macmillan Company, 1912. 323 pp. Price, $2 net.

The volume before us is calculated to present to English-speaking readers the same kind of material as is very excellently provided for the German world by the well-known handbook "Minerva," namely, a survey with brief biographical notes of the most important contemporary men of science, arranged in alphabetical order. The book is in its first edition, and it is perhaps only to be expected that in certain points it leaves room for amplification and perhaps improvement in later editions. As we turn over the leaves casually, we are struck with the fact that the space given to each name cannot be in any measure regarded as in any sense an indication of the importance of the man. Thus, for instance, opposite the name of "Nernst" we find but six lines of text, while against the name of some men of very much more modest achievements we occasionally find three or four times as much matter. This is not in itself necessarily a very serious fault, as it is generally understood that in matters of this kind the inch rule is not the right measure to apply. Nevertheless, it does suggest that perhaps in a future edition the space apportioned to each man might be a little more in proportion to his importance. In addition to the main text, which is arranged in dictionary form, there are some tables of the world's universities, giving, among other things, the names of the principal professors. At the back of the volume is an index, in which the names are classified according to the branch of science in which the men in question are actively engaged, and according to their geographical location. This is a very useful index and, so far as the reviewer can recall, is new in a volume of this kind. To those who do not command German with sufficient readiness to consult "Minerva" with ease, the present volume should prove valuable. As it is built up on a somewhat different plan from "Minerva," it should be of use even to those who are accustomed to consulting "Minerva," in which, as the reader is probably aware, the names are arranged according to universities, which latter themselves appear in alphabetical order. Books of this kind have a usefulness quite their own, which those who have occasion to consult them appreciate without having it specially pointed out. No further recommendation is therefore needed for this book than to say that it well fulfills its purpose.

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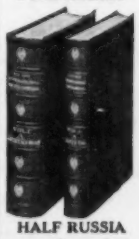

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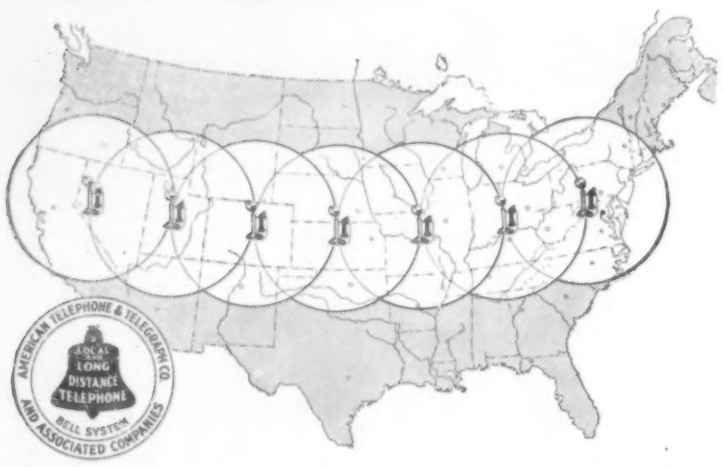

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¶ In a word, the June mid-month number will show you what Hamlet meant when he inquired:

"Why may not imagination trace the noble dust of Alexander till we find it stopping a bunghole?"

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A TEXTBOOK OF PHYSICS. By Louis Bevier Spinney. New York: The Macmillan Company, 1911. 8vo.; 605 pp.; illustrated. Price, $2.75 net.

There are so many text-books on the general subject of physics that any claim of superiority must rest largely upon the arrangement of material and the proportional emphasis laid upon the sub-topics of the study. Prof. Spinney's endeavor has been to lay stress upon Mechanics, as a branch of physics that, although of fundamental importance, is often presented in such a way as to lack appeal. The most attractive and up-to-date illustrations possible are employed in dealing with vector analysis, force and torque, energy transformation, etc. The arrangement of subjects is based on sound reasoning. Being an elementary work, intended for class-room use, the demonstrations of principles have been made in the simplest possible way, and mathematical aspects have been for the most part left for maturer consideration.

THE BOYS' BOOK OF WARSHIPS. By J. R. Howden. New York: Frederick A. Stokes Company. 8vo.; 297 pp.; illustrated. Price, $2.

The author of the "Boys' Book of Steamships," here gives us another excellent volume which most men as well as boys might read to advantage. The introductory chapter tells of the development of the fighting ship from the galleys of Egypt and the five-bankers of Athens and Rome to England's awakening under Henry VII., and her defeat of the formidable Armada a century later. Her progress toward mastery of the seas is then chronicled, and the advent of steam is given an interesting chapter. The first armored vessel for the British navy was the "Warrior," laid down in 1859. From this event the development of armor is sketched. There are chapters showing just how a modern ironclad is designed, built, and launched, and others classifying modern battleships under their respective types. Cruisers, torpedo boats, and submarines have their share of attention, and under the caption, "The Work and Working of a Man-of-War," we find one of the most charming and instructive papers of the volume. A hundred good illustrations show all phases of the construction, equipment, and handling of the modern fighting machines of all nations.

WITHIN THE MIND MAZE. By Edgar Lucien Larkin, Director of the Lowe Observatory, Mount Lowe, California. Los Angeles: Standard Printing Company, 1911. 180 pp.; illustrated. Price, $1.25.

Prof. Larkin's book is more metaphysical than scientific. From the first page to the last it reads more like speculation than a sober presentation of scientific facts. Indeed, the little science in it is not always correct. For example, in the account of J. Butler Burke's experiments with the so-called radiophobes, no mention is made of the fact that the discoveries made by Burke were completely disposed of by Sir William Ramsay on good chemical grounds. Furthermore, the experiments of Leduc with so-called artificial plants are easily explained by osmotic pressure and surface tension. Similarly, Prof. Larkin allows to pass without any critical commentary the alleged discovery by Dr. Yamaguchi of thought forms.

MEMOIR RELATING TO THE FOUNDATION OF AN INTERNATIONAL INSTITUTE OF CHEMISTRY. By Wilhelm Ostwald. Leipzig: Akademische Verlagsgesellschaft M. B. H., 1912. 30 pp.

Of late years, since laying aside his professorship in the Leipzig University, Ostwald has divided his energies mainly between the writing of books and essays of a more or less philosophical character and taking an active part in the organization and propagation of various movements in which he takes a personal interest, and on which he is peculiarly qualified to speak and act. The little memoir before us is devoted to the exposition of the need for an international institute of chemistry, and its proposed functions. Ostwald points out that there is a vast amount of duplication of work, particularly in the searching of chemical literature in connection with every kind of research that is going on throughout the civilized world, and also in the preparing of abstracts of the current chemical literature. As a matter of fact, all important chemical literature is abstracted in the journals of the London Chemical Society, of the American Chemical Society, in the Zentralblatt of the German Chemical Society, and the journal of the French Chemical Society, to say nothing of other publications of minor importance. One of the functions of the institute proposed would be to centralize this abstracting work and to perfect it. Ostwald rightly points out that if a special staff of men perform the task of abstracting as a life work, they would acquire a facility and expert knowledge which cannot be commanded by the workers on the present system, who, as a rule, fulfill the function of abstractors for a comparatively brief period at a time when they find it desirable or necessary to add to the rather scanty income which the professional man is apt to receive during the earlier years of his active life. Another great advantage which would be gained is that any search of literature once made for any particular purpose would become the common property of all and always be accessible for use; thus a vast amount of duplicate work would be avoided. The institute should serve some other functions also; thus, for instance, it is proposed that it should comprise a museum of chemical specimens. No doubt the details of the functions which the institute would ultimately fulfill may be left to some extent to the future. As regards the means of realization of the plan, one notes

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with interest and appreciation that a quarter of a million of francs ($50,000) has been promised by Ernest Solvay, the founder of the Solvay Institute in Brussels, on condition that the plans as finally framed meet with his approval. Ostwald himself estimates the first cost of the institute at about 600,000 marks ($143,000) to be supplemented by annual contributions for five or ten years of 50,000 marks ($12,500). Ostwald also proposes to donate his private library, consisting of some 7,000 volumes and 12,000 reprints, for the library of the institute.

THE NEW GARDEN OF CANADA. By Pack Horse and Canoe Through Undeveloped British Columbia. By F. A. Talbot. New York: Cassell & Co., Ltd., 1911. 12mo.; 308 pp. Price, $2.50 net.

Mr. Talbot is well known to our readers as the English correspondent of the SCIENTIFIC AMERICAN. Some two years ago Mr. Talbot visited the United States and Canada and made an exhaustive study of transportation and other facilities in the great Dominion across the border. In the present volume, which is the second which Mr. Talbot has given to the world on Canada in the last few months, he deals particularly with British Columbia. The object of Mr. Talbot's investigation was to obtain some information of the economic and scenic value of the country traversed. This was no easy undertaking, for new British Columbia is a territory of which it is difficult to form comparative estimates. Mr. Talbot prophesies great things for this corner of British North America. The book is profusely illustrated with a large number of plates, and there is also an excellent map. The book is very interesting.

PHYSICAL AND CHEMICAL CONSTANTS AND SOME MATHEMATICAL FUNCTIONS. By G. W. C. Kaye and T. H. Laby. London and New York: Longmans, Green & Co. 153 pp.

Every person who is engaged in scientific or technical work picks up a new book or tables of constants with curiosity and interest which appears to remain unabated, in spite of the fact that such tables have of recent years been published in considerable variety and in all languages. We have before us a new compilation of this kind which, in addition to the material customarily embodied in such collections, presents some features of novelty, that bring the book right up to the front of modern scientific work. We find, for instance, a synopsis of molecular dimensions, tables of mobilities of ions in gases, the ionic charge e, ratio $\frac{e}{m}$, ionization by alpha rays, vapor pressure of radium emanation, constants of radio-active substances, and numerous other data of this character. Of the mathematical tables embodied in the book may be mentioned a short table of the exponential function, 4-figure logarithms, anti-logarithms, 5-figure logarithms, reciprocals, squares, natural trigonometric functions and radian measure. The reviewer feels disposed to take this opportunity of mentioning a void which exists in all the most accessible collections of tables, in that it is peculiarly difficult to find a ready source giving the natural logarithms and exponential functions over more than a small range. Presumably, the need of this has not been very severely felt: otherwise, these data would have been incorporated more frequently in the tables that have appeared from time to time. As it is, we are forced to use common logarithms and convert them into the natural logarithms whenever required. The publishers' technique in the production of this book is all that can be desired, and as there is a good index and the ground covered is broad and thoroughly modern the book should be found an exceedingly valuable addition to the library or on the desk of every technical and scientific man.

AN AMERICAN RAILROAD BUILDER. JOHN MURRAY FORBES. By Henry Greenleaf Pearson. New York: Houghton Mifflin Company, 1911. 8vo.; 196 pp.; illustrated. Price, $1.25 net.

This is one of the readable biographies of which the publishers have lately been making a specialty. These biographies have a meaning above that of the individual life. They are as a rule vitally connected with some phases of national life and development, and in this particular the volume in hand is no exception to the rule. Forbes played a prominent part in the development of the railroad system of the Middle West. His story runs parallel to the story of railroad finance between the years 1846 and 1881. It is distinguished by a sort of heroic honesty upheld by an imagination almost prophetic. The volume is in some respects an abridgment of the earlier "Life and Recollections," but throws into stronger light the achievements of his most virile years.

THE INHERITANCE OF ACQUIRED CHARACTERS. By Eugenio Rignano. Translated by Basil C. H. Harvey, of the University of Chicago. Chicago: The Open Court Publishing Company, 1911. 8vo.; 413 pp. Price, $3 net.

The heat of the controversy centering about heredity is proof of the appeal of the subject. Rignano approaches it from the viewpoint of the philosopher rather than from that of the specialist. What training he has had is that of the engineer and physicist. His theories are developed from a physical basis, and suggest a mechanism which may conceivably bring about the inheritance of acquired characters. The author was himself predisposed to disbelieve in such inheritance, but a deeper study of the phenomena which in turn corroborate and threaten the theories of simple epigenesis and preformation has led him to offer a

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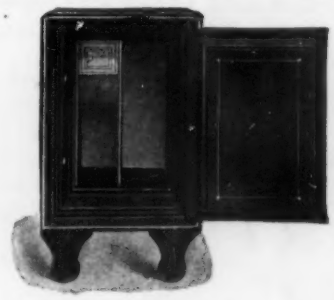

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THE MECHANISM OF NATURE. By Henry C. Ehlers. Clearbrook, Washington: Henry C. Ehlers, 1911. 12mo.; 221 pp. Price, $1.

We opened the little volume quite lightheartedly. From its title, we deemed it to be a simple presentation of mechanical principles as exemplified in the flight of the stag beetle or the action of a frog's legs. A frog is indeed mentioned, but only to tell us that the kick of his hind legs exerts an influence upon the morning star. In brief, the work constructs for us a new heaven and a new earth, in that it presents new theories of the constitution of matter and of the phenomena of force. Matter is assumed to be continuous throughout the universe, and of two kinds, "void" or unorganized, and substantial, or organized. Void matter is composed of primary spheres, a primary sphere being the last possible subdivision of material. In organized matter these primary spheres are combined into atoms, which atoms are interlocked in solids and uninterlocked in liquids and gases. Force is not inherent in matter, and cannot be stored up in any material. For its transmission, the bodies affected must be unequal. All display of force is accompanied by a change of void into organized matter, and a compensatory change of organized into void matter. Force is always in the nature of a pressure—a push, and never an attraction. Whatever may be the difficulty of accepting this new exposition as a satisfactory explanation of the constitution of matter—and the author himself admits the work to be but a suggestive study—we can but admire the logical arrangement and treatment of the propositions, and the genius with which the most abstract of them is demonstrated with the aid of BB shot or a cask of water. No one will sleep over the work, and it certainly imparts an attitude of refreshment and expectation which is the result of taking a new viewpoint of a large subject.

THE STRANGE CASE OF DR. BRUNO. By F. E. Daniel, M.D. Austin, Texas: Von Boeckmann-Jones Company. Price, $1.50.

The story of Dr. Bruno and his uncanny researches is far removed from the present-day orthodox novel with its love and the petty obstacles thereto that, swept away, leave the man and the woman in each other's arms at the end of the last chapter. The real and fancied relationships which make the plot possible become so intricate as to be almost bewildering. But perhaps the main interest for the reader of scientific bent lies in Dr. Bruno's attempt to find and to reproduce the molecular construction of that secretion which the mud-wasp injects into her victims, causing an almost complete suspension of vital functions without actually destroying life. Not a few of humanity's greatest physiological, social, and moral problems are brought into the limelight, and examined in a virile manner from unusual points of view. The tale is at the same time instructive and absorbing, and its most extreme theorems are advanced with so matter-of-fact an attention to detail that their plausibility seems beyond question.

PHYSICAL OPTICS. By Robert W. Wood. New York: The Macmillan Company, 1911. 705 pp.; illustrated. Price, $5.25 net.

The book before us not only represents a very excellent textbook on the subject referred to in the title, but displays considerable originality and is a refreshing departure from many of the more stereotyped works. The author's personality is strongly impressed upon the whole book, and numerous references to his own work tend to give that touch of personal interest which can never be found in a mere compilation.

Some idea of the general arrangement of the book can be gathered from the chapter headings, the list of which is as follows:

I. The Nature of Light. II. Rectilinear Propagation of Light. III. The Reflection of Light from Plane and Curved Surfaces. IV. Refraction of Light. V. Dispersion. VI. Interference of Light. VII. The Diffraction of Light. VIII. Interference of Spectroscopes and the Resolution of Special Lines. IX. Polarization of Light. X. Double Refraction. XI. Circular and Elliptical Polarization. XII. Meteorological Optics. XIII. Theory of Reflection and Refraction. XIV. The Theory of Dispersion. XV. Absorption of Light. XVI. Optical Properties of Metals. XVII. Rotary Polarization. XVIII. Magneto Optics. XIX. Electro-Optics. XX. Transformation of Absorbed Radiation. Fluorescence, Phosphorescence, and Resonance-Radiation. XXI. Laws of Radiation. XXII. Scattering of Light by Small Obstacles. Optical Resonance. XXIII. The Nature of White Light. XXIV. The Relative Motion of Ether and Matter. XXV. The Principle of Relativity.

The book represents a great deal of information contained in a comparatively small compass. A chapter which the reviewer read with particular pleasure was the last, dealing with the Principle of Relativity. This subject is in the mind of every physicist nowadays, and has also received considerable attention among lay people. The presentation given here, though, of course, very brief, is nevertheless very excellent.

There is one criticism which one feels disposed to make with regard to the book, namely, that the material of which it is made is considerably below the standard of the treatment of the subject matter. The print is moderately good, though rather closer than one likes to see it. The paper is thin and rather poor, and some of the illustrations are distinctly poor, the paper apparently being unsuited for half-tone reproductions. There are one or two colored plates, which are severely marred by the fact that no tissue paper has been interposed between them and the printed page, and in the copy which the reviewer has before him fiber from the adjoining page has adhered to the colored plate so as to deface it. It seems a great pity that a book which otherwise is very excellent should be deficient in matters of this kind. It is true that they will not seriously affect the value of the work, which is to be highly recommended, but they may possibly deter the casual observer from taking as much interest in the book as it deserves.

THE DAWN OF BRITISH HISTORY. By Alice Corkran. New York: Thomas Y. Crowell & Co. 12mo.; 248 pp.; illustrated. Price, $1.25.

Dawn, like spring, is a time of awakenings, stirrings, and expectancy. Without straining after effect, the author knows how to make the old, simple tales of England's beginning take to themselves a note so vibrant that it impresses us as new. We see people and times awakening, stirring restlessly, and arousing themselves to struggle and achievement as the promise of coming glories shines like the sun into their dazzled eyes. The history begins with the voyage of Pythias, that earlier Columbus who adventured without chart or compass in search of the land of tin. Stonehenge and its forgotten rites; the ancient Britons and their handicrafts, superstitions, and warfare; the old legends, and the immortal dramas they later inspired; the birth of London-town: the coming of the Romans—all these and many other chapters of British history are charmingly related, and the final withdrawal of the Romans brings to a close a volume that should lead many boys and girls to desert their story-books.

THE FLYING GIRL. By Edith Van Dyne. Chicago: The Reilly & Britton Company, 1911. 12mo.; 232 pp.; illustrated. Price, $1 net.

The author of the "Aunt Jane Series" believes that girls are as eager toward the development of aviation as boys. She gives us, therefore, a story in which the young heroine is a past mistress at the game, and where, in the crisis of the story, she not only wins a battle in the air, but actually rescues from falling the man who would have hurled her to her death. It was only after consultation with Wilbur Wright and Glenn H. Curtiss that the episode was passed upon as being little in advance of our present achievements and well within the bounds of possibility.

HAZELL'S ANNUAL, 1912. Edited by Hammond Hall. London: Hazell, Watson & Viney, Ltd., 1912. 592 pp.

Hazell's Annual for this year includes the provisions of the Anglo-Russian Convention with regard to Persia and the story of the events leading up to the present crisis; the chief features of Mr. Gladstone's Home Rule bills compared and contrasted in parallel columns; the story of the Morocco crisis, illustrated with an excellent map showing the territorial relations of Germany, France, Spain and Belgium in the region of the Congo; ministerial pronouncements on electoral reform, supplemented by an explanation of the chief systems of proportional representation; an exhaustive summary of the insurance bill, followed by a comparison of Mr. Lloyd-George's scheme with that in existence in Germany; besides much valuable information on music, art, sport and the drama. There have been many stirring events in English politics, as well as in international politics during the last year, and in Hazell's Annual they have been recorded impartially.

LA PRATIQUE COMMERCIALE. By J. H. Haendel. Paris: O. Doin et Fils, 1911. 12mo.; 378 pp.; illustrated.

The chief drawback of so condensed a consideration of so large a subject lies in the impossibility of doing more than sketching the bare branches of which Commercial Practice is the parent tree. The author defines agriculture, industry and commerce in their relations to one another. Commercial organization in its broadest sense is regarded as a triad of buyer, seller, and accountant, and its history is traced from the simplest up to the most complex forms. The art of advertising is discussed in a chapter of considerable length, and is illustrated by cuts from French and American periodicals. Corporations, office devices, competition, the middle-man, the rise of the employee to the position of employer, the qualities requisite to success, and other phases of the subject, are treated of in a very general manner.

THE WILD BEASTS OF THE WORLD. By Frank Finn, B.A., F.Z.S. New York: Frederick A. Stokes Company. 4to; 404 pp.; illustrated. Price, $3.75 net.

The large type and vivid brush-work of this natural history should make it a favorite with the young. Between three and four hundred different animals are described, many being given two or three pages of text. There are a hundred illustrations in full colors from drawings by a trio of artists, those by C. E. Swan being particularly striking both from the life-like execution of the animals and the artistic treatment of the backgrounds.

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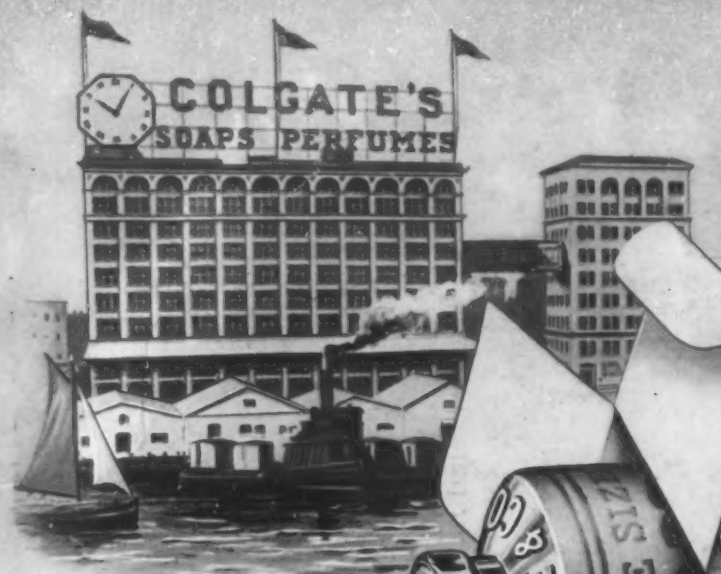

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